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Publication 186

July 1997

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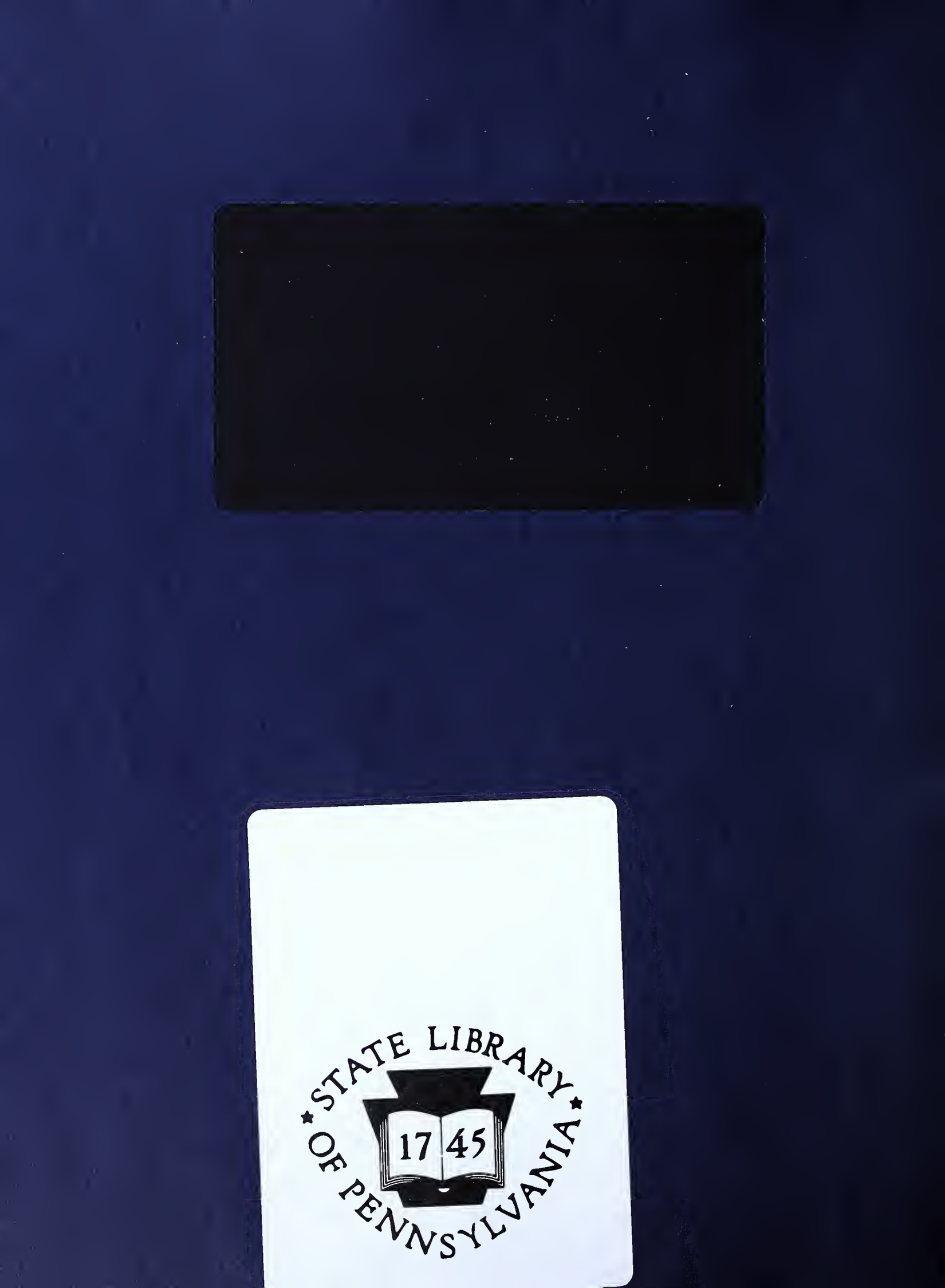
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Publication 186 *July 1997*

Water Quality & Monitoring Programs Division
Susquehanna River Basin Commission

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The Susquehanna River Basin Commission was created as an independent agency by a federal-interstate compact* among the states of Maryland, New York, Commonwealth of Pennsylvania, and the federal government. In creating the Commission, the Congress and state legislatures formally recognized the water resources of the Susquehanna River Basin as a regional asset vested with local, state, and national interests for which all the parties share responsibility. As the single federal-interstate water resources agency with basinwide authority, the Commission's goal is to effect coordinated planning, conservation, management, utilization, development and control of basin water resources among the government and private sectors.

**Statutory Citations: Federal - Pub. L. 91-575, 84 Stat. 1509 (December 1970); Maryland - Natural Resources Sec. 8-301 (Michie 1974); New York - ECL Sec. 21-1301 (McKinney 1973); and Pennsylvania - 32 P.S. 820.1 (Supp. 1976).*

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Water Quality and Biological Assessment of the Middle Susquehanna Subbasin, 1993

ABSTRACT

Water quality, habitat, and biological data collected during summer low flow conditions were used to assess the ecological integrity of 19 Susquehanna River and 56 tributary sites between Ulster and Sunbury, Pennsylvania.

Cluster analysis of the water quality data suggests the presence of eight tributary water quality categories and three Susquehanna River categories. The water quality characteristics of the tributary categories appear to be related to the proportion of forest and agricultural lands within the watershed, urban/suburban land uses, and the degree to which the streams are impacted by acid mine drainage (AMD). Susquehanna River water quality categories appear to be influenced by a combination of major point sources, AMD, and the chemical quality of nearby tributaries.

Water quality had a substantial impact on the biological communities in the Middle Susquehanna Subbasin. Streams in relatively pristine areas of the subbasin supported healthy macroinvertebrate communities. The biological communities of streams in watersheds that contained some agricultural land and sparse population areas tended to be non-impaired or slightly impaired. Streams impacted by sewage treatment plants and other forms of urbanization were characterized by high nutrient concentrations and low alkalinity that result in slightly to moderately impaired biological communities. The biological communities of several streams with good to excellent habitat conditions were severely impaired due to AMD. Habitat conditions at 83 percent of the sites were rated as either excellent or supporting, and biological conditions at 71 percent of the sites were either non-impaired or slightly impaired.

INTRODUCTION

The Susquehanna River Basin Commission (SRBC) conducts stream assessment surveys within the six major subbasins of the Susquehanna River, on a 10 to 12 year rotation to evaluate the water quality and biological condition in each subbasin. Previous subbasin surveys conducted during the period 1982-86 have provided much documentation on the quality of streams in the Susquehanna River Basin.

LaBuy (1967) conducted a biological survey of the Susquehanna River and tributaries between Cooperstown, New York, and Northumberland, Pennsylvania. He found a healthy biological community in the subreach between the New York/Pennsylvania border and the Wyoming Valley, marginal to severely degraded conditions within the Wyoming Valley, and improving conditions downstream. Malione and others (1984) conducted a water quality and biological survey of the Susquehanna River and its tributaries between the New York-Pennsylvania border and Sunbury, Pa., during July and August 1982, and found conditions improved, but similar to those found by LaBuy.

Study Area

The Middle Susquehanna Subbasin, between Ulster and Sunbury, Pa., drains an area of approximately 3,700 square miles of northeastern Pennsylvania, and includes all or part of Bradford, Columbia, Lackawanna, Luzerne, Montour, Northumberland, Schuylkill, Sullivan, Wayne, and Wyoming Counties in Pennsylvania (Figure 1.) Land use/land cover consists primarily of forest and agriculture with less than 8 percent of the basin being classified as urban or built-up.

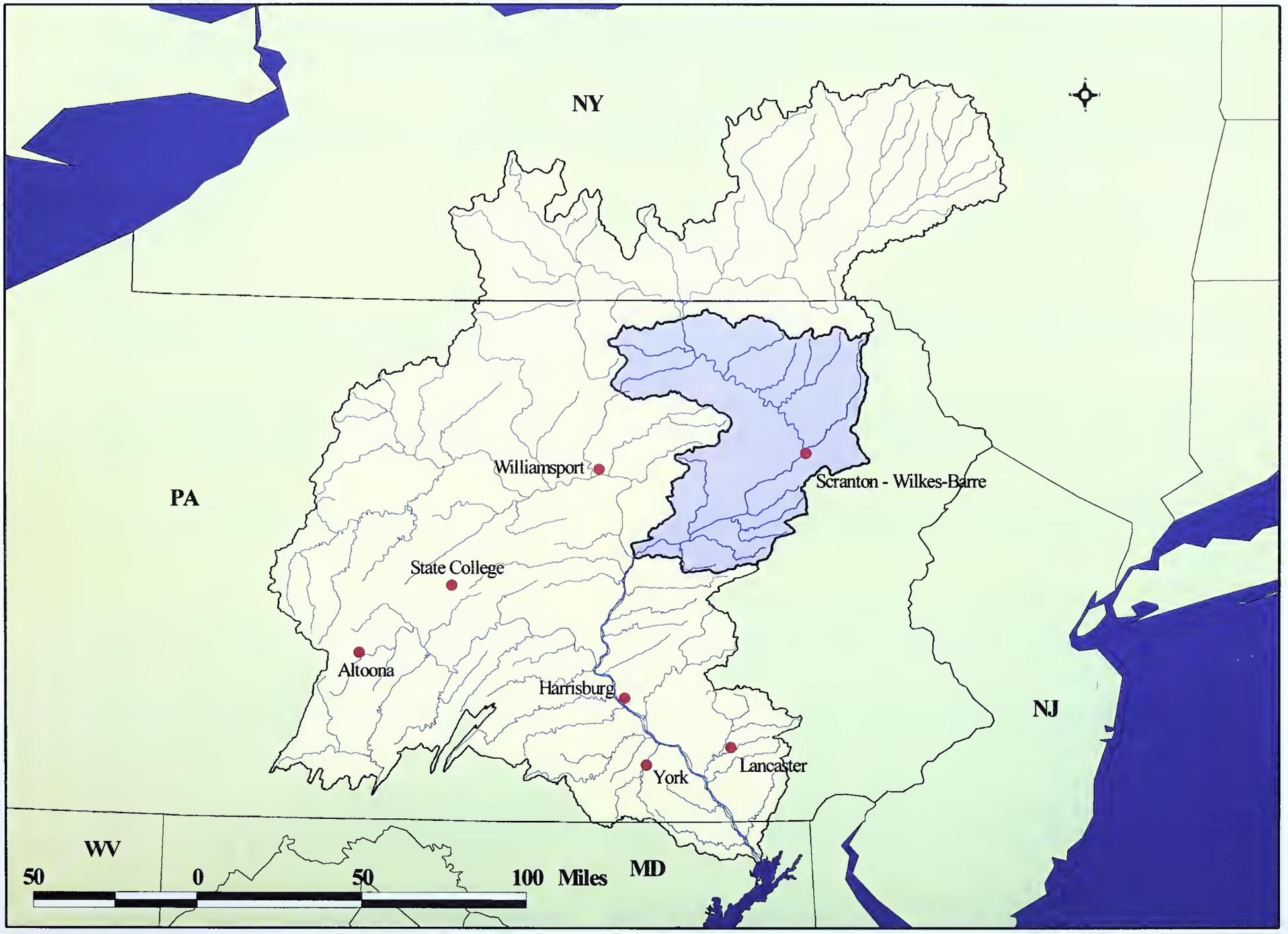

Figure 1. Map Showing Location of the Middle Susquehanna Subbasin Study Area

Generally, population centers are located in the Susquehanna River valley. The largest is the Scranton/Wilkes-Barre metropolitan area, with a population of approximately 200,000. Other significant population centers include Hazleton, Berwick, and Bloomsburg, located in the southern part of the subbasin.

Objectives

The objectives of this study were to: (1) provide the SRBC, the U.S. Environmental Protection Agency (US EPA), and the Pennsylvania Department of Environmental Protection (Pa. DEP) with information to be used in their Section 305(b) Water Quality Assessment Reports; and (2) identify the existence, severity, and probable cause(s) of impairment to stream biological communities.

DATA COLLECTION

Monitoring Sites

The sample sites used by Malione and others (1984) served as a framework for the sampling locations used in this study. Sample sites were based on differences in geologic setting, changes in land use, and locations of known point source discharges. In addition, Susquehanna River sites were located so that the effects of major tributaries on the river could be evaluated. Seventy-five sample sites were selected, with 19 sites located on the Susquehanna River and 56 sites distributed among 26 tributary watersheds (Figures 2 and 3). These sample site locations are listed in Table 1.

Water Quality

Data were collected in July and August 1993, under summer low flow conditions. Field chemistry measurements included dissolved oxygen, conductivity, pH, alkalinity, and acidity. Dissolved oxygen was measured using a YSI dissolved oxygen meter or by the Winkler titration method. Conductivity was measured using a Beckman Solubridge meter. An Orion Model 399A meter was used to measure pH. Alkalinity was measured by titrating a known volume of sample water to pH 4.5 with 0.2N H_2SO_4. Acidity was measured by titrating a known volume of sample water to pH 8.3 with 0.2N NaOH. Approximately two liters of water were collected at each station for laboratory analysis. Two 500 ml samples were taken for nutrient analysis (one filtered and one unfiltered), and two 500 ml samples were taken for metal analysis (one filtered and one unfiltered). Sample water was filtered through a cellulose nitrate filter with a 0.45 µm pore size. Filters were changed at each station. The samples for metal analyses were acidified to pH 2 or less with nitric acid. All samples were chilled on ice, and shipped within 24 hours to the Pa. DEP, Bureau of Laboratories in Harrisburg, Pennsylvania. The water quality parameters analyzed are listed in Table 2. The results of laboratory analysis of samples collected from the Middle Susquehanna Subbasin are shown in Appendix A.

Physical Habitat

Eleven habitat parameters were evaluated in the field at each station. Habitat parameters were separated into three categories: primary, secondary, and tertiary parameters. The primary parameters, features that have the greatest direct influence on the structure of aquatic communities such as the characterization of the stream bottom substrate, instream cover, embeddedness, and velocity/depth diversity, were evaluated on a scale of 0 to 20. Secondary parameters included stream channel morphology characteristics (stream channel alteration, bottom scour and deposition, pool-riffle ratio, and lower bank channel capacity), and were scored on a scale of 0 to 15. Tertiary parameters characterized riparian and bank conditions, and were scored on a scale of 0 to 10. These parameters included upper bank stability, bank vegetative protection or disruption, stream-side cover, and riparian vegetative zone width. The habitat evaluation scores were recorded on a Habitat Assessment Field Data Sheet (Figure 4).

Table 1. Middle Susquehanna River and Tributary Sampling Sites

Sampling Site	Susquehanna River Sampling Sites Location
SUSQ 280.0	Ulster Township, Bradford County, 1.5 miles above Ulster Village
SUSQ 271.0	Towanda Borough, Bradford County, SR 0006 bridge
SUSQ 269.0	Just above mouth of Wysox Creek, Wysox Township, Bradford County
SUSQ 254.0	Just above mouth of Wyalusing Creek, Wyalusing Borough, Bradford County
SUSQ 230.0	North Mehoopany Village, Mehoopany Township, Wyoming County, SR 0087 bridge
SUSQ 228.0	Mehoopany Township, Wyoming County, below SR 0087 bridge, 0.5 mile below Proctor & Gamble discharge
SUSQ 219.0	Tunkhannock Borough, Wyoming County, above SR 0029 bridge
SUSQ 207.0	Falls Village, Falls Township, Wyoming County, SR 0092 bridge
SUSQ 198.0	Coxton railroad bridge, above Lackawanna River confluence, Luzerne County
SUSQ 190.0	Wilkes Barre City, Luzerne County, SR 0309 bridge
SUSQ 181.0	Nanticoke Borough, Luzerne County, railroad bridge
SUSQ 171.0	Shickshinny Borough, Luzerne County, SR 0239 bridge
SUSQ 163.0	Beech Haven Village, Nescopeck Township, Luzerne County, 3 miles above SR 0093 bridge
SUSQ 156.0	Mifflinville Borough, Columbia County, SR 2028 bridge
SUSQ 14805	Bloomsburg Town, Columbia County, SR 0487 bridge
SUSQ 146.2	Bloomsburg Town, Columbia County, railroad bridge, below Fishing Creek
SUSQ 136.0	Danville Borough, Montour County, SR 0054 bridge
SUSQ134.5	Riverside Borough, Northumberland County, just below Merck discharge
SUSQ 125.0	Sunbury City, Northumberland County, at Conrail Bridge
	Tributary Sampling Sites Location
SRC 00.8	Sugar Creek, North Towanda Township, Bradford County, SR 3022 bridge, RM 274.0
SRC 16.4	Sugar Creek near West Burlington Village, West Burlington Township, Bradford County, SR 3019 bridge
TWN 00.1	Towanda Creek, RM 270.0, 0.1 mile above mouth, Bradford County
TWN 16.9	Towanda Creek, Woodruff Corners, Leroy Township, Bradford County, T 328 bridge
WSX 00.2	Wysox Creek, Wysox Township, Bradford County, RM 267.0, 0.2 mile above mouth
WSX 06.6	Wysox Creek near Rome Borough, Bradford County, T 699 bridge
WYL 00.4	Wyalusing Creek, RM 251.0, 0.4 mile above mouth, Bradford County
WYL 16.2	Wyalusing Creek, Bradford County, 16.2 miles above mouth
SGRR 00.3	Sugar Run at Sugar Run Village, Wilmot Township, Bradford County, SR 2002 bridge, RM 239.0
MSH 00.1	Meshoppen Creek, RM 233.0, 0.1 mile above mouth, Wyoming County
MSH 05.3	Meshoppen Creek, upstream from White Creek, Wyoming County, SR 029, near Lemon Village, Lemon Township, Wyoming County
MHO 00.1	Mehoopany Creek, Mehoopany Township, Wyoming County, RM 230.0, 0.1 mile above mouth
MHO 06.5	Mehoopany Creek, Forkston Township, Wyoming County, off SR 0087, near North Branch Township
TNK 00.3	Tunkhannock Creek, RM 218.0, 0.3 mile above mouth, Wyoming County
TNK 11.3	Tunkhannock Creek, Starkville Village, Nicholson Township, Wyoming County, off SR 0092
BOW 00.1	Bowman Creek, RM 216.5, 0.1 mile above mouth, Wyoming County
BOW 12.5	Bowman Creek near Noxen Village, Noxen Township, Wyoming County, off SR 0029
LWR 00.3	Lackawanna River near Pittston City, Luzerne County, RM 197.0, 0.3 mile above mouth
LWR 04.0	Lackawanna River, 4.0 miles upstream from mouth, Luzerne County
LWR 15.0	Lackawanna River near mouth of Leggetts Creek, Lackawanna County
LWR 36.0	Lackawanna River near Forest City Borough, Lackawanna County

Table 1. Middle Susquehanna River and Tributary Sampling Sites —Continued

Sampling Site	Tributary Sampling Sites Location
LGT 00.1	Leggetts Creek at mouth, Lackawanna County
RRB 00.1	Roaring Brook, 0.1 mile above mouth, Lackawanna County
TBY 00.2	Toby Creek at Edwardsville Borough, Luzerne County, SR 0011 bridge, RM 186.6, 0.2 mile above mouth
TBY 06.7	Toby Creek, Trucksville Village, Kingston Township, Luzerne County, near SR 0309
SOL 00.9	Solomon Creek, Hanover Township, Luzerne County, RM 185.5, first road bridge over creek
NTK 00.4	Nanticoke Creek at mouth, RM 182.0, Luzerne County
NPT 00.1	Newport Creek, RM 180.5, immediately above mouth, Luzerne County
HRV 00.1	Harveys Creek, RM 180, immediately above mouth, Luzerne County
HRV 06.8	Harveys Creek, Lehman Township, Luzerne County, below Spring Brook Reservoir off SR 1061
HNL 00.2	Hunlock Creek near mouth, RM 177.0, below SR 0011 bridge, Luzerne County
HNL 04.5	Hunlock Creek, Hunlock Township, Luzerne County, off SR 4003
SHK 00.1	Shickshinny Creek near Shickshinny Borough, Luzerne County, RM 171.2, 50 feet above mouth
SHK 04.5	Shickshinny Creek, Union Township, Luzerne County, SR 4007 bridge
LWWP 00.1	Little Wapwallopen Creek, Conyngham Township, Luzerne County, RM 167.0, 100 feet above mouth
LWWP 06.7	Little Wapwallopen Creek, Dorance Township, Luzerne County, T 387 bridge
WWP 00.1	Wapwallopen Creek, Nescopeck Township, Luzerne County, new SR 0239 bridge, RM 165
WWP 06.4	Wapwallopen Creek, Hollenback Township, Luzerne County, T 392 bridge
NSK 00.7	Nescopeck Creek, Nescopeck Borough, Luzerne County, SR 0339 bridge
NSK 13.2	Nescopeck Creek, Sugarloaf Township, Luzerne County, T 338 bridge
NSK 13.9	Nescopeck Creek, Sugarloaf Township, Luzerne County, T 340 bridge
BLK 00.1	Black Creek at mouth, Black Creek Township, Luzerne County, above SR 3016 bridge
BLK 09.3	Black Creek, Hazle Township, Luzerne County, SR 0093 bridge
BRR 00.4	Briar Creek, Briar Creek Borough, Columbia County, SR 0011 bridge
WBRR 02.4	West Branch Briar Creek, North Centre Township, Columbia County, T 730 bridge
EBRR 04.7	East Branch Briar Creek, Briar Creek Township, Columbia County, SR 1017 bridge
FSH 01.5	Fishing Creek, Bloomsburg Town, Columbia County, SR 4003 bridge, RM 146.5
FSH 15.6	Fishing Creek, Fishing Creek Township, Columbia County, SR 0487 bridge
LFSH 00.1	Little Fishing Creek, Hemlock Township, Columbia County,0.1 mile above mouth
HNT 00.2	Huntington Creek, Fishing Creek Township, Columbia County, SR 1020 bridge
CAT 00.2	Catawissa Creek, Catawissa Borough, Columbia County, SR 3014 bridge, RM 145
CAT 13.0	Catawissa Creek, West Shumans Village, Beaver Township, Columbia County, ST 0339 bridge
RRC 01.1	Roaring Creek, Mayberry Township, Montour County, off T 313, RM 141.5
RRC 10.7	Roaring Creek, Locust Township, Columbia County, SR 0042 bridge
SRBC 00.5	South Branch Roaring Creek, Franklin Township, Columbia County, T 369 bridge
MAH 00.8	Mahoning Creek, Danville Borough, Montour County, adjacent to park

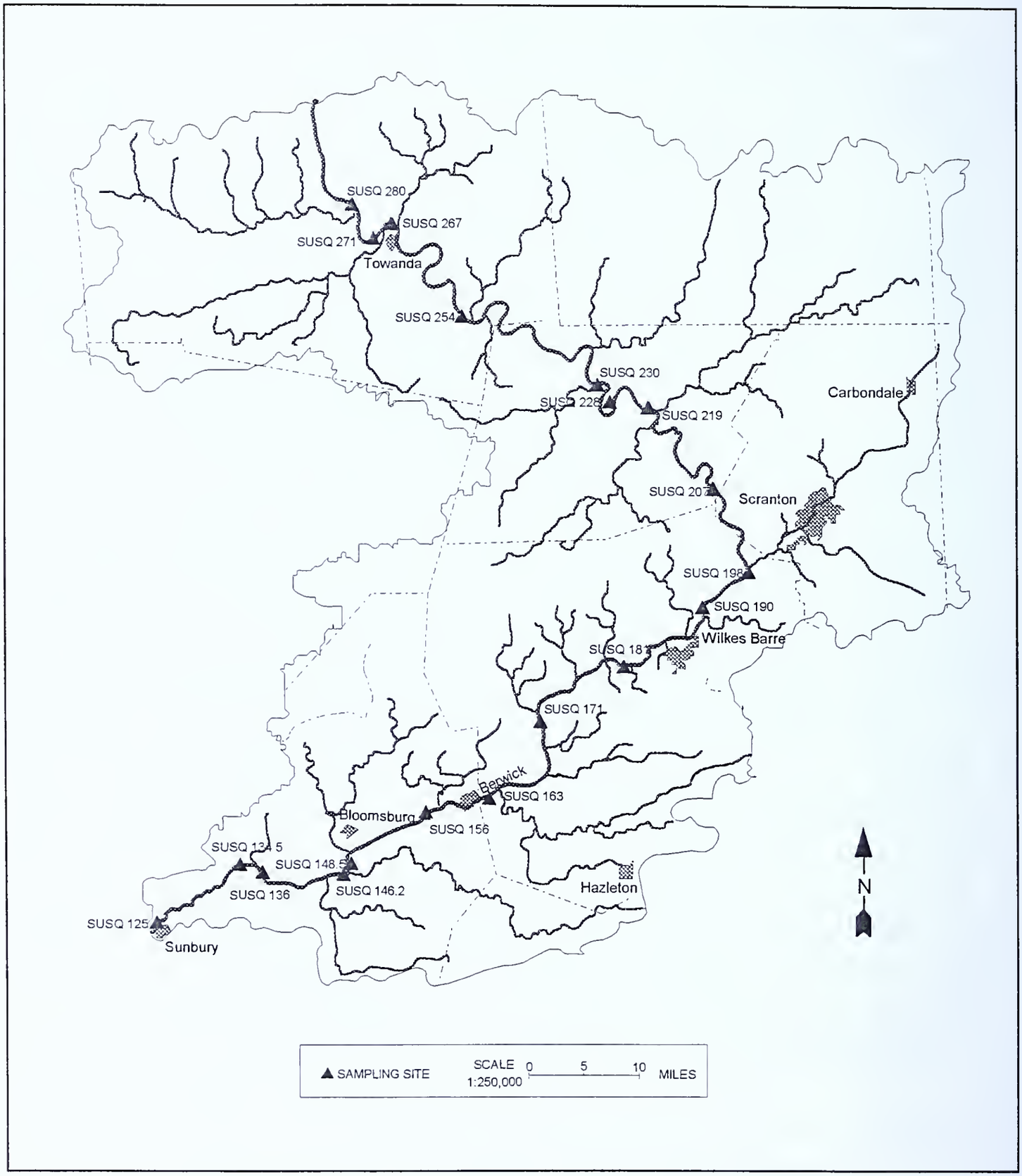

Figure 2. Map Showing Locations of Middle Susquehanna River Sampling Sites

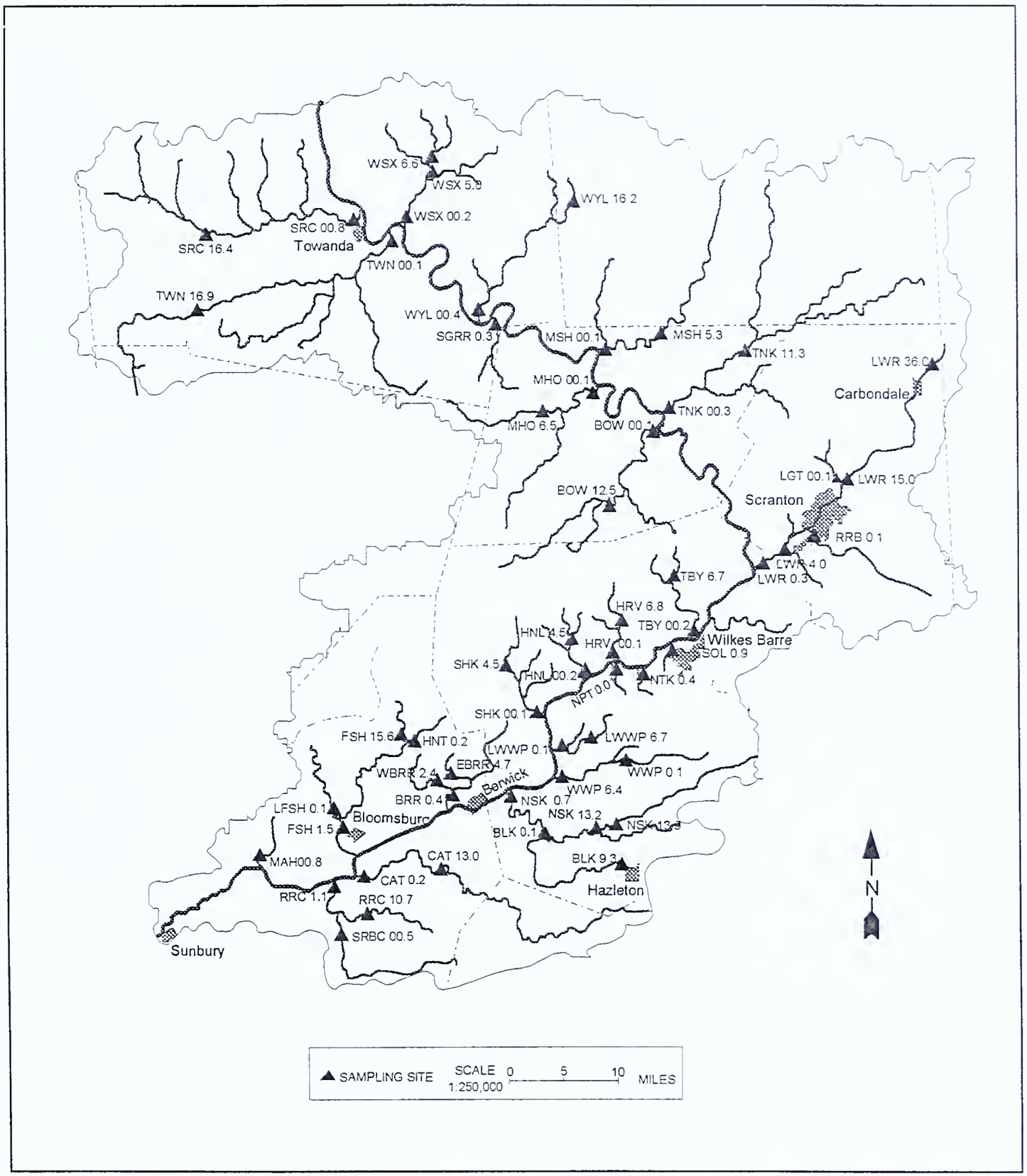

Figure 3. Map Showing Location of Middle Susquehanna Tributary Sampling Sites

Table 2. Parameter List for the Middle Susquehanna Subbasin Survey

Field Parameters
1. Temperature, C
2. Streamflow—instantaneous cfs
3. pH
4. Conductivity
5. Dissolved Oxygen
6. Acidity
7. Alkalinity

Laboratory Analysis
1. Alkalinity
2. Total Dissolved Solids
3. Ammonia-N, Total and Dissolved
4. Nitrogen, Total and Dissolved
5. Nitrite-N, Total and Dissolved
6. Nitrate-N, Total and Dissolved
7. Phosphorus, Total and Dissolved
8. Orthophosphate, Total
9. Hardness, Total
10. Sodium, Total
11. Potassium, Total
12. Magnesium, Total
13. Calcium, Total
14. Chlorides, Total
15. Sulfate, Total
16. Fluoride, Total
17. Iron, Total and Dissolved
18. Manganese, Total and Dissolved
19. Aluminum, Total and Dissolved
20. Lead, Total
21. Copper, Total
22. Zinc, Total
23. Nickel, Total
24. Organic Carbon, Total

HABITAT ASSESSMENT FIELD DATA SHEET

SITE ID _____ WATERBODY NAME _____
DATE _____ AQUATIC ECOREGION _____
TIME _____ STREAM DESIGNATION _____

HABITAT SCORING SHEET

Score

BOTTOM SUBSTRATE ..... _____

Substrate Type	Diameter	Percent
Bedrock	solid	_____
Boulder	> 10 in	_____
Cobble	2.5-10 in	_____
Gravel	0.1-2.5 in	_____
Sand	gritty	_____
Silt		_____
Clay	slick	_____
Detritus	sticks, leaves	_____
Muck	organic black	_____

EMBEDDEDNESS ..... _____
Are underside of rocks black? Y or N

CANOPY COVER ..... _____
Stream shading _____ %

CHANNEL ALTERATION ..... _____
Type mod/obstruct _____

BOTTOM SCOURING & DEPOSITION ..... _____

POOL-RIFFLE AND RUN-BEND RATIO ..... _____
Pool/Riffle _____ft/_____ft

LOWER BANK CHANNEL CAPACITY ..... _____

UPPER BANK STABILITY ..... _____

BANK VEGETATIVE PROT. OR DISRUPTION ..... _____

STREAMSIDE COVER ..... _____
Left Bank _____
Right Bank _____
(Right and Left looking upstream based on dominant vegetation)

RIPARIAN VEGETATIVE ZONE WIDTH ..... _____

TOTAL SCORE ..... _____

Figure 4. Habitat Assessment Field Data Sheet

Biological Conditions

Benthic macroinvertebrate communities were sampled using kick nets with size No. 30 mesh to collect organisms dislodged from riffle areas by physical agitation of the stream substrate. Two areas of the streambed, each approximately 1 meter square, were sampled at each site; one area of high velocity, and one of lower velocity. The two samples were composited and preserved for laboratory analysis in a solution of isopropyl alcohol and glycerin. In the laboratory, the composite samples were sorted into 100-organism subsamples using a gridded pan and a random numbers table. The organisms contained in the subsamples were identified to genus (except for Chironomidae, Culicidae, and Tubificidae), enumerated, and assigned an organic pollution tolerance value and to a functional feeding group. Organic pollution tolerance values and functional feeding groups designations are summarized in Appendix B.

DATA ANALYSIS

Water Quality

A cluster analysis was performed on a data set of 20 water quality parameters, using software developed by Kovach (1993), to group sampling stations with similar water quality characteristics into water quality categories. The parameters included in the cluster analysis are summarized in Table 3.

Physical Habitat

The ecoregion geographical framework developed by Omernik (1987) was used to group ecologically similar tributary stations into reference categories. Each ecoregion includes a group of water bodies that would have similar environmental conditions and aquatic living resources, if undisturbed,by human activities. The three ecoregions in the Middle Susquehanna Subbasin are described in Table 4.

Tributary sampling stations were designated as either within a small or large stream, based on stream drainage area and stream order (determined from USGS 1:250,000 scale topographic maps) relative to the other sites in the same ecoregion. This classification process, based on ecoregion designation and stream size, categorized tributary sampling stations into one of five reference categories. From each reference category, one station that represented a combination of the "best attainable" habitat and biological conditions was selected as the reference site for its particular reference category. Reference categories and sites are summarized in Table 5. All Susquehanna River stations were grouped into a single reference category.

Habitat Conditions

Habitat conditions at each sampling station were assessed using a slightly modified version of the habitat assessment procedure outlined by Plafkin and others (1989). Eleven habitat parameters were field-evaluated at each station, and used to calculate a site-specific Habitat Assessment Score. Habitat Assessment Scores were used to assess the habitat conditions of sampling stations relative to those of reference stations and to classify each sampling station into a Habitat Condition Category using the criteria shown in Table 6.

Table 3. Water Quality Parameters Used in Cluster Analysis of Middle Susquehanna River and Tributary Sample Sites

General and Nutrient Parameters	Major Ions	Metals
pH (field)	Calcium	Copper (Total)
Alkalinity (field)	Magnesium	Iron (Total)
Acidity (field)	Sodium	Lead (Total)
Total Ammonia	Potassium	Manganese (Total)
Total Nitrogen	Chloride	Nickel (Total)
Total Phosphorus	Sulfate	Zinc (Total)
Total Organic Carbon		Aluminum (Total)

Table 4. Description of Ecoregions Within the Middle Susquehanna Subbasin (Omernik, 1987)

Ecoregion	Land-Surface Form	Potential Natural Vegetation	Land Use	Soils
60 Northern Appalachian Plateau	Open high hills, tablelands with moderate to considerable relief	Northern hardwoods (maple, birch, beech, hemlock)	Mosaic of cropland, pasture, woodland, and forest	Inceptisols
62 North Central Appalachians	Open high hills to open low mountains, low mountains	Northern hardwoods (maple, birch, beech, hemlock), northern hardwoods/spruce (maple, birch, beech, spruce, hemlock)	Forest and woodland mostly ungrazed	Frigid Inceptisols
67 Central Appalachian Ridges and Valleys	Open low hills to open low mountains, low mountains	Appalachian oak	Mosaic of cropland and pasture with some woodland and forest	Mesic Inceptisols

Table 5. Summary of the Middle Susquehanna Tributary Sampling Sites by Reference Categories

Stream Name	Sampling Site (1)	Reference Category (2)	Stream Name	Sampling Site (1)	Reference Category (2)
Harveys Cr.	**HRV 6.8**	**60.1**	Harveys Cr.	HRV 0.1	67.1
Meshoppen Cr.	MSH 5.3	60.1	Hunlock Cr.	HNL 0.2	67.1
Hunlock Cr.	HNL 4.5	60.1	South Br. Roaring Cr.	SBRC 0.5	67.1
Wysox Cr.	WSX 6.6	60.1	West Br. Briar Cr.	WBRR 2.4	67.1
Sugar Cr.	SRC 16.4	60.1	Shickshinny Cr.	SHK 4.5	67.1
Towanda Cr.	TWN 16.9	60.1	Wapwallopen Cr.	WWP 6.4	67.1
Sugar Run	SGRR 0.3	60.1	Wapwallopen Cr.	WWP 0.1	67.1
Toby Cr.	TBY 6.7	60.1	Mahoning Cr.	MAH 0.8	67.1
Wysox Cr.	**WSX 0.2**	**60.2**	Roaring Brook	RRB 0.1	67.1
Towanda Cr.	TWN 0.1	60.2	Black Cr.	BLK 0.1	67.1
Tunkhannock Cr.	TNK 11.3	60.2	Black Cr.	BLK 9.3	67.1
Bowman Cr.	BOW 0.1	60.2	Toby Cr.	TBY 0.2	67.1
Meshoppen Cr.	MSH 0.1	60.2	Leggetts Cr.	LGT 0.1	67.1
Wyalusing Cr.	WYL 16.2	60.2	Newport Cr.	NPT 0.1	67.1
Wyalusing Cr.	WYL 0.4	60.2	Solomon Cr.	SOL 0.9	67.1
Sugar Cr.	SRC 0.8	60.2	Nanticoke Cr.	NTK 0.4	67.1
Mehoopany Cr.	MHO 0.1	60.2	**Fishing Cr.**	**FSH 15.6**	**67.2**
Tunkhannock Cr.	TNK 0.3	60.2	Nescopeck Cr.	NSK 13.9	67.2
Bowman Cr.	**BOW 12.5**	**62**	Fishing Cr.	FSH 1.5	67.2
Mehoopany Cr.	MHO 6.5	62	Roaring Cr.	RRC 1.1	67.2
Roaring Cr.	**RRC 10.7**	**67.1**	Huntington Cr.	HNT 0.2	67.2
Little Wapwallopen Cr.	LWWP 0.1	67.1	Lackawanna River	LWR 4.0	67.2
Shickshinny Cr.	SHK 0.1	67.1	Lackawanna River	LWR 15.0	67.2
Briar Cr.	BRR 0.4	67.1	Nescopeck Cr.	NSK 0.7	67.2
East Br. Briar Cr.	EBRR 4.7	67.1	Catawissa Cr.	CAT 13.0	67.2
Little Wapwallopen Cr.	LWWP 6.7	67.1	Lackawanna River	LWR 0.3	67.2
Lackawanna River	LWR 36.0	67.1	Catawissa Cr.	CAT 0.2	67.2
Little Fishing Cr.	LFSH 0.1	67.1	Nescopeck Cr.	NSK 13.2	67.2

(1) Numbers indicate the location of the sample station with respect to miles above the stream's mouth.

(2) Reference Category 60.1 and 60.2—small and large streams, respectively, in the Northern Appalachian Plateau and Uplands Ecoregion. Reference site in bold letters.

Reference Category 62—in the North Central Appalachians Ecoregion. Reference site in bold letters.

Reference Category 67.1 and 67.2—small and large streams, respectively, in the Central Appalachian Ridges and Valleys Ecoregion. Reference site in bold letters.

Table 6. Summary of Criteria Used to Classify Habitat Conditions of Sampling Sites

DETERMINATION OF HABITAT ASSESSMENT SCORES				
	Habitat Parameter Scoring Criteria			
Parameter	Excellent	Good	Fair	Poor
Bottom Substrate and Available Cover	20-16	15-11	10-6	5-0
Embeddedness	20-16	15-11	10-6	5-0
Canopy Cover	20-16	15-11	10-6	5-0
Channel Alteration	15-12	11-8	7-4	3-0
Bottom Scour and Deposition	15-12	11-8	7-4	3-0
Pool-Riffle, Run-Bend Ratio	15-12	11-8	7-4	3-0
Lower Bank Channel Capacity	15-12	11-8	7-4	3-0
Upper Bank Stability	10-9	8-6	5-3	2-0
Bank Vegetative Protection or Disruption	10-9	8-6	5-3	2-0
Streamside Cover	10-9	8-6	5-3	2-0
Riparian Vegetative Zone Width	10-9	8-6	5-3	2-0
Habitat Assessment Score (a)				

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↓
↓

HABITAT ASSESSMENT	
Percent Comparability of Study and Reference Site Habitat Assessment Scores	**Habitat Condition Category**
>90	Excellent (comparable to reference)
89-75	Supporting
74-60	Partially Supporting
<60	Nonsupporting

(a) Habitat Assessment Score = Sum of Habitat Parameter Scores

Biological Conditions

Biological conditions of each site were assessed based on benthic macroinvertebrate community integrity using the US EPA's Rapid Bioassessment Protocols for Use in Streams and Rivers (RBP III) (Plafkin and others 1989). Benthic macroinvertebrate community integrity was evaluated using slightly modified versions of the eight RBP III metrics. These modifications include the substitution of Shannon Diversity (log base 2) for the Percent Contribution of Dominant Taxa metric and the calculation of the Percent Shredder metric score from the composited riffle sample, instead of a separate coarse particulate organic matter (CPOM) sample. Percent similarity was used to quantify community similarity between sample and reference communities. Shannon Diversity and Percent Similarity were calculated using software developed by Kovach (1993). The metrics used in this study are summarized in Table 7.

The 100-organism subsample data were used to calculate numerical values for the eight metrics for each sample site. Each of the eight metric values was assigned a Biological Condition Score, according to the comparability (percent similarity) of these values with the corresponding metric values calculated for the reference site. The sum of the Biological Condition Scores constituted the Total Biological Score for the sample site. Benthic macroinvertebrate community integrity at each site was summarized by assigning the site to a Biological Condition Category. Determination of the Biological Condition Category for each sample site was based on the comparability (percent similarity) of the site's Total Biological Score to that of the appropriate reference site. The criteria used to determine the Biological Condition Category are summarized in Table 8. Raw benthic macroinvertebrate data are tabulated in Appendix C.

Table 7. Metrics Used in Assessing Biological Conditions

Metric	Description
1. Taxonomic Richness (1)	The total number of taxa present in the 100 organism subsample
2. Modified Hilsenhoff Biotic Index (1)*	A measure of the organic pollution tolerance of a benthic macroinvertebrate community
3. Ratio of Scrapers/Filtering Collectors (1)*	That ratio of the total number of scrapers to filtering collectors in the 100 organism subsample
4. Ratio of EPT/Chironomids (1)	The ratio of the total number of EPT individuals to Chironomidae in the 100 organism subsample
5. Shannon Diversity Index (2)	A measure of biological community complexity based on the number of equally or nearly equally abundant taxa in the community
6. EPT Index (1)	The total number of Ephemeroptera (mayfly), Plecoptera (stonefly), and Trichoptera (caddisfly) taxa present in the 100 organism subsample
7. Percent Similarity (2)	A measure of the similarity between the taxonomic composition of the sample site and its appropriate reference site
8. Percent Shredder (3)*	The percent composition of shredder individuals in the 100 organism subsample

Sources: (1) Plafkin and others (1989);
(2) Calculated using software developed by Kovach (1993); and
(3) Modified from Plafkin and others (1989).

* Organic pollution tolerance values and functional feeding group designations are summarized in Appendix B.

Table 8. Summary of Criteria Used to Classify the Biological Conditions of Sampling Sites

SAMPLING AND ANALYSIS

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TOTAL BIOLOGICAL SCORE DETERMINATION

Metric	Biological Condition Scoring Criteria (percent) 6	4	2	0
1. Taxonomic Richness (a)	>80	79-60	59-40	<40
2. Modified Hilsenhoff Biotic Index (b)	>85	84-70	69-50	<50
3. Ratio of Scrapers/Filtering Collectors (a, c)	>50	49-35	34-20	<20
4. Ratio of EPT/Chironomids (a)	>75	74-50	49-25	<25
5. Shannon Diversity Index	>75	74-50	49-25	<25
6. EPT Index (a)	>90	89-80	79-70	<70
7. Percent Similarity (d)	>45	44-33	32-20	<20
8. Percent Shredder (a, c)	>50	49-35	34-20	<20
Total Biological Score (e)				

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BIOASSESSMENT

Percent Comparability of Study and Reference Site Total Biological Scores	Biological Condition Category
>81	Non-impaired
81-53	Slightly Impaired
52-20	Moderately Impaired
<20	Severely Impaired

(a) Score is study site value/reference site value X 100.
(b) Score is reference site value/study site value X 100.
(c) Functional Feeding Group Designations are summarized in Appendix A.
(d) Range of values obtained. A comparison to the reference station is incorporated in this index.
(e) Total Biological Score = the sum of Biological Condition Scores assigned to each metric.

RESULTS

Water Quality

Cluster analysis of the tributary and Susquehanna River water quality data suggests the presence of eight tributary water quality categories and three Susquehanna River categories. These categories, designated as T1 through T8 for the tributary sites and R1 through R3 for the river sites, are shown in Figures 5 and 6, respectively, and are described below.

T1 sites are generally the most pristine, and are located in predominantly forested watersheds. Major cation and anion concentrations are low, and are considered background or ambient concentrations. Nutrient and metal concentrations are characteristic of natural conditions.

T2 sites are similar to T1 sites, but there are some indications of small nitrogen inputs, probably from agricultural land uses. These sites are located in mixed forested and agricultural watersheds with the population sparsely scattered throughout the watershed. Forest is the predominant land use. Major ion concentrations are slightly higher than in the T1 sites, but are still considered low.

T3 sites are located in mixed agricultural and forested watersheds, but agriculture is the major land-use. Population is scattered throughout the watershed, and includes some small villages and towns. The major cation concentrations are higher than the ambient conditions in the T1 streams. The increase in the major cations also is reflected in higher pH and total alkalinity. Nutrient concentrations are similar to that of T2 sites.

T4 sites are located in two types of watersheds where streams have a high pH and high cation concentrations. The first type contains streams located in an urban/suburban valley. Major cation and nutrient concentrations are high, indicating pollution impacts. Elevated total phosphorus concentrations suggest point source discharges. The second type contains streams with naturally moderate alkalinity. Any increase in nutrient concentrations are either from point or nonpoint pollution sources, but concentrations are not as high as in the urban/suburban type watershed.

T5 sites are found in a variety of land use settings. These sites are characterized by both low to moderate alkalinity and moderate acidity. Major cation concentrations are less than that of T4 sites, and concentrations of both total nitrogen and phosphorus are very high.

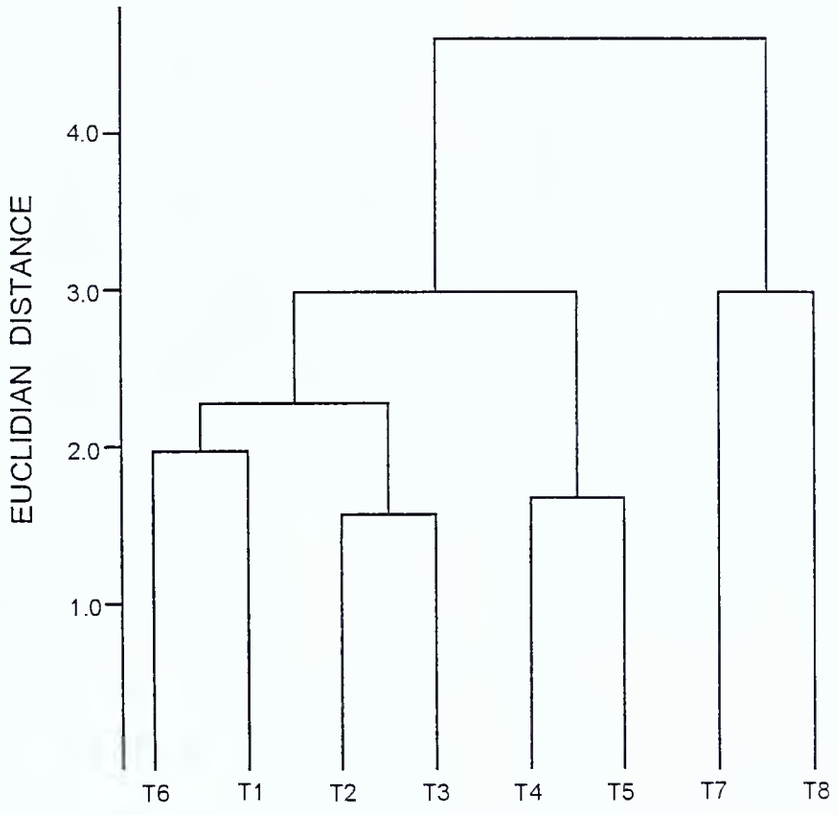
T6 sites represent one class of AMD impacted streams, and are characterized by very low iron concentrations. Metals most commonly found are aluminum and manganese, with zinc and nickel sometimes present. Generally, metals concentrations are the lowest for T6 sites, compared to T7 and T8 sites.

T7 sites are located in AMD impacted streams that contain high buffering capacity, due to the presence of very high concentrations of alkaline materials. The alkaline materials could be natural or due to human influences. Because of the higher alkalinity, pH is not as low as in T6 and T8 sites. Very high iron and manganese concentrations exist; however, zinc and aluminum are present in low concentrations.

T8 sites are in AMD impacted streams and exhibit very high acidity and correspondingly very low pH and alkalinity. This condition provides a stream environment that maintains very high metal concentrations. Unlike T6 and T7 sites, lead is sometime present.

R1 sites, located on the Susquehanna River, exhibit the highest pH values found in the subbasin. Acidity is very low or nonexistent. Total organic carbon concentrations are generally higher at these river sites, compared to tributary stream sites.

R2 sites contain similar water quality values as the R1 sites, but are in a separate class due to an increase in ammonia and a decrease in sulfate. This may be due to a major point source input.



T6	T1	T2	T3	T4	T5	T7	T8
CAT 0.2	BOW 12.5	BLK 9.3	BOW 0.1	LGT 0.1	BLK 0.1	LWR 0.3	NSK 0.7
CAT 13.0	LWWP 0.1	EBRR 4.7	BRR 0.4	LWR 15.0	TBY 0.2	NPT 0.1	NSK 13.2
	MHO 0.1	FSH 1.5	LFSH 0.1	LWR 4.0	WWP 6.4	NTK 0.4	
	MHO 6.5	FSH 15.6	LWR 36.0	MAH 0.8	WYL 0.4	SOL 0.9	
	RRC 10.7	HNL 0.2	MSH 0.1	RRB 0.1			
	SHK 0.1	HNL 4.5	MSH 5.3	SRC 0.8			
		HNT 0.2	SGRR 0.3	SRC 16.4			
		HRV 0.1	TNK 0.3	TBY 6.7			
		HRV 6.8	TWN 0.1				
		LWWP 6.7	TWN 16.9				
		NSK 13.9	WBRR 2.4				
		RRC 1.1	WSX 00.2				
		SHK 4.5	WYL 16.2				
		SRBC 0.5					
		TNK 11.3					
		WSX 6.6					
		WWP 0.1					

Figure 5. Results of Cluster Analysis Performed on Water Quality Data From Middle Susquehanna Tributary Sampling Sites

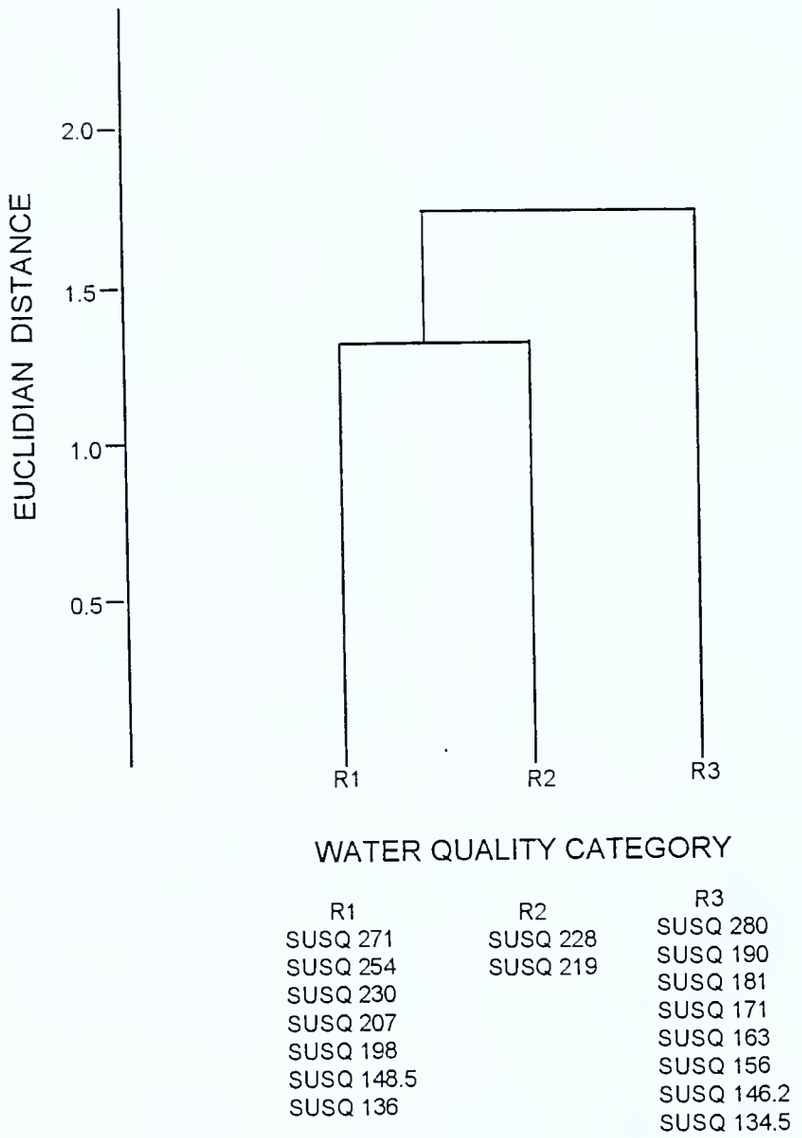


Figure 6. Results of Cluster Analysis Performed on Water Quality Data From Middle Susquehanna River Sampling Sites

R3 sites represent locations on the Susquehanna River influenced by an increase in nutrients and the effects of AMD inputs. Although the pH values are high, the range in pH is lower than that of the R1 and R2 sites.

Water quality categories of the Susquehanna River and tributary sites are shown in Figures 7 and 8, respectively.

In general, the water quality characteristics of categories T1, T2, and T3 sites were somewhat variable, and appeared to be related to the proportion of forest and agricultural land use within the watershed and the degree to which these land uses impacted background water quality. The T4 and T5 stations were generally impacted by more urban/suburban land uses, while the T6, T7, and T8 water quality categories represented various AMD impacted streams.

Habitat and Biological Conditions

The Susquehanna River and its tributaries within the Middle Susquehanna Subbasin support a diverse benthic macroinvertebrate community. Ninety-five genera representing 57 families from 15 orders were observed in the subbasin. The most common taxon in the subbasin was the family Chironomidae (midges), which was observed at 84 percent of the sample stations. Common taxonomic orders were Ephemeroptera (mayflies), which accounted for 23 genera, Trichoptera (caddisflies), and Coleoptera (aquatic beetles). Other macroinvertebrate taxa that were common include the following genera: common netspinning caddisflies (Genus: *Cheumatopsyche*); riffle beetles (Genus: *Stenelmis*); and brushlegged mayflies (Genus: *Isonychia*).

The procedures described in Rapid Bioassessment Protocols for Use in Streams and Rivers (Plafkin and others, 1989) suggest that the results of the biological survey be integrated with the habitat and water quality data to assess the overall ecological condition of each site. This method assumes that the attainable biological condition of a stream is primarily determined by the quality of the habitat available at that site. Habitat, as the principle determinant of biological potential, provides a basis for interpreting biosurvey results, and can be used as a general predictor of biological condition.

In the absence of water quality effects, the relationship between habitat quality and biological condition can be roughly viewed as a linear curve, with the biological community increasing as habitat quality increases (Figure 9, Curve II). When water quality effects are incorporated into the relationship, two additional responses may be observed. Curve I represents the relationship between habitat quality and the biological condition when nutrient enrichment is present in a stream. Excessive nutrient concentrations may sustain an artificial macroinvertebrate population in the absence of quality habitat. Curve III illustrates the effect that organic pollutants or toxicants have on the biological community. The presence of organic pollutants or toxicants in a stream result in a stressed biological community, regardless of the quality of the habitat. The relationships between habitat conditions and biological scores for each reference category are presented in the following discussions.

Reference Category 60.1

Reference category 60.1 is characterized by small headwater streams on the northern Appalachian Plateau Ecoregion. Harveys Creek, at stream mile 6.8, was used as the reference site for streams in this category. Habitat and biological assessments were conducted on eight streams in this reference category. The assessment scores are shown in Table 9. Habitat conditions of all these sites were classified as either supporting or comparable to those of the reference site. The biological condition of two of the sites were non-impaired, and six sites were slightly impaired. Figure 10 shows the relationship between habitat conditions and biological scores for streams in this reference category. This graph indicates streams in the 60.1 reference category generally have suitable habitat conditions and good macroinvertebrate populations. Many of these

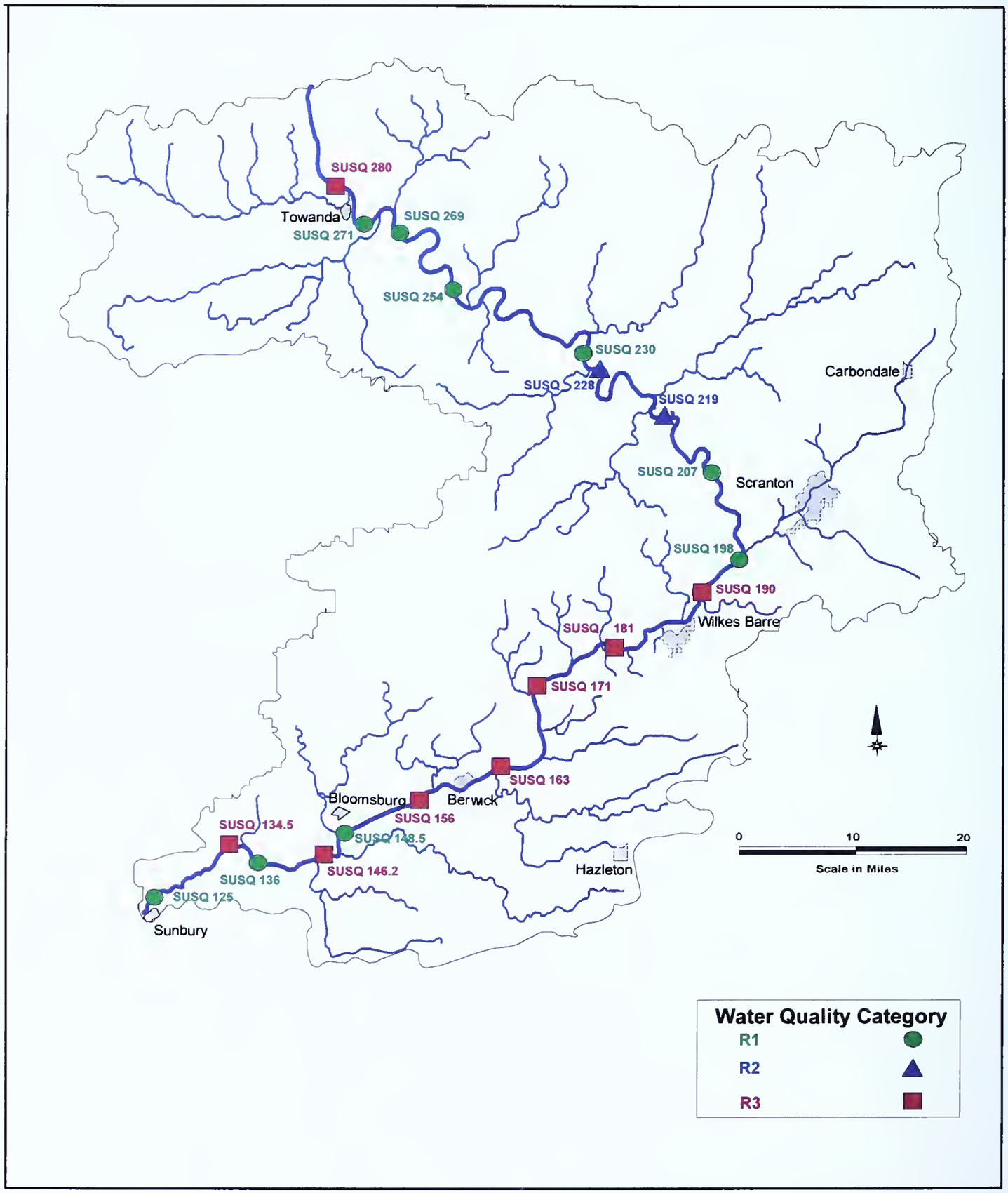


Figure 7. Map Showing Water Quality Categories of the Middle Susquehanna River Sampling Sites

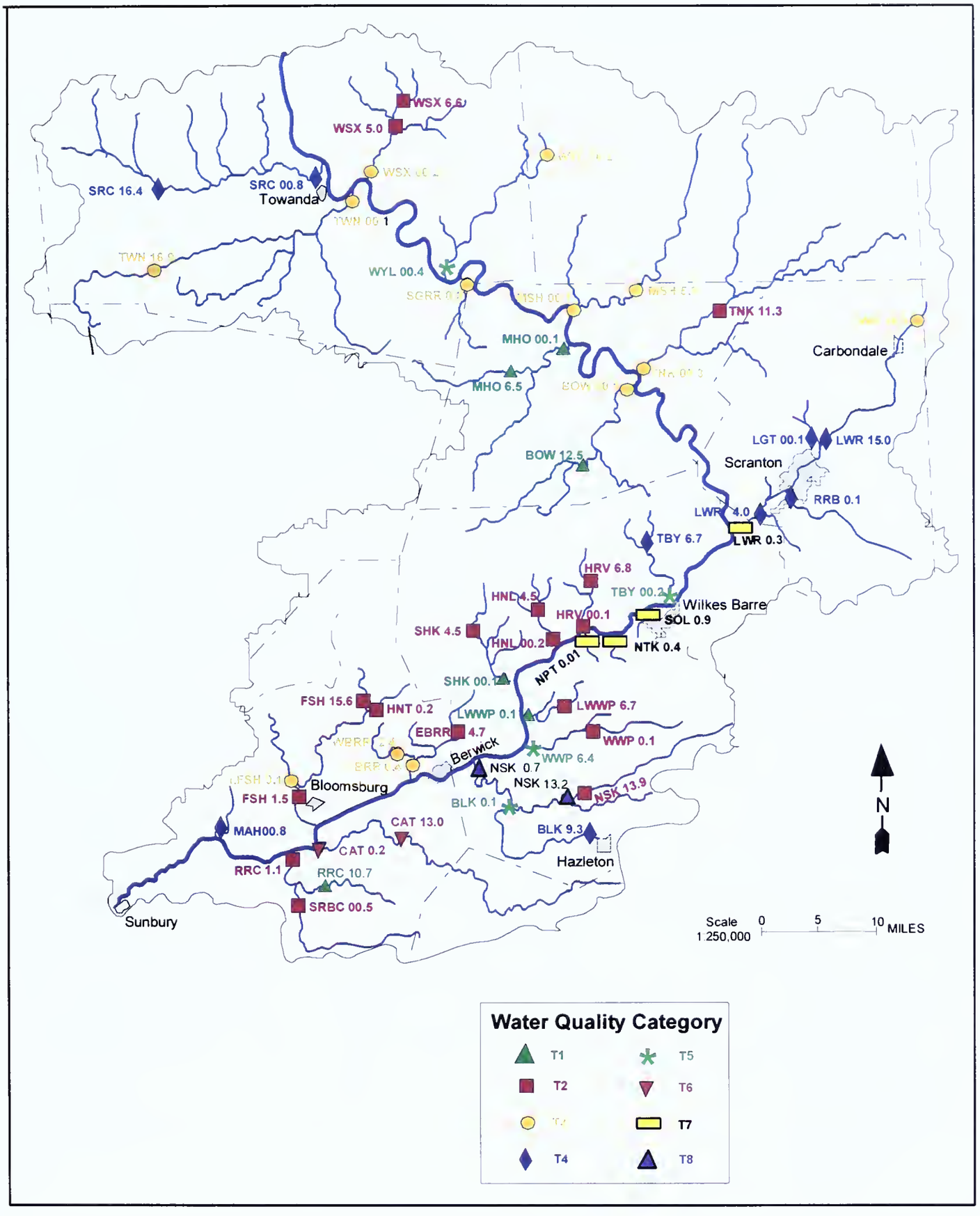


Figure 8. Map Showing Water Quality Categories of the Middle Susquehanna Tributary Sampling Sites

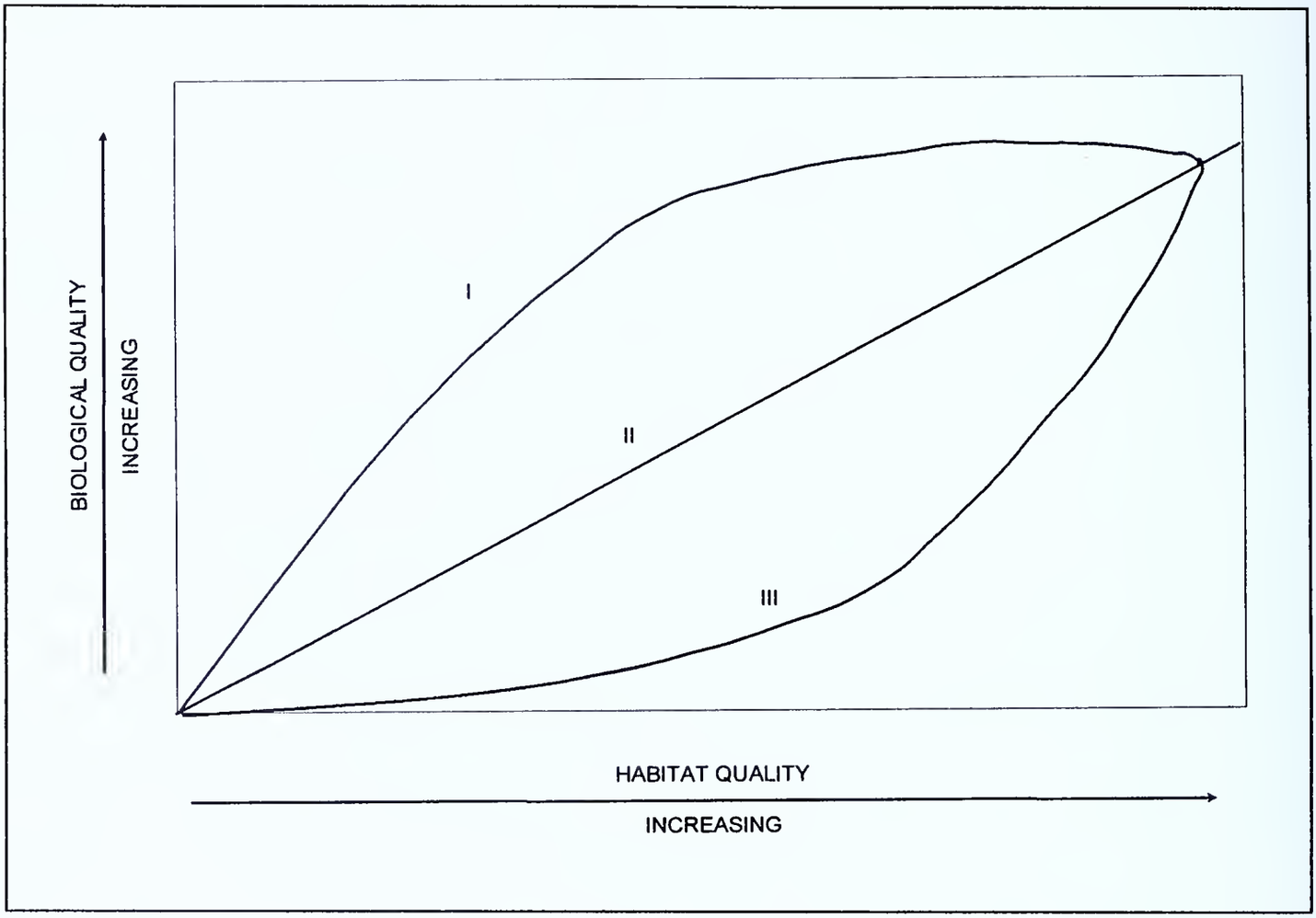


Figure 9. Relationship of Habitat Quality and Biological Condition in the Context of Water Quality

Table 9. Biological and Habitat Assessment Scores of Sampling Sites and Percent Comparability With Reference Site HRV 6.8 in Ecoregion 60.1

Stream Name	Sampling Site (1)	Reference Category (2)	Biological		Habitat	
			Total Score	Percent Compatibility	Total Score	Percent Compatibility
Harveys Cr.	**HRV 6.8**	**60.1**	**48**	**100**	**136**	**100**
Meshoppen Cr.	MSH 5.3	60.1	40	83	135	99
Hunlock Cr.	HNL 4.5	60.1	36	75	127	93
Wysox Cr.	WSX 6.6	60.1	32	67	113	83
Sugar Cr.	SRC 16.4	60.1	32	67	113	83
Towanda Cr.	TWN 16.9	60.1	30	63	118	87
Sugar Run	SGRR 0.3	60.1	28	58	119	88
Toby Cr.	TBY 6.7	60.1	28	58	127	93

(1) Numbers indicate the location of the sample station with respect to miles above the stream's mouth.
(2) Reference Category 60.1—small streams in the Northern Appalachian Plateau and Uplands Ecoregion.

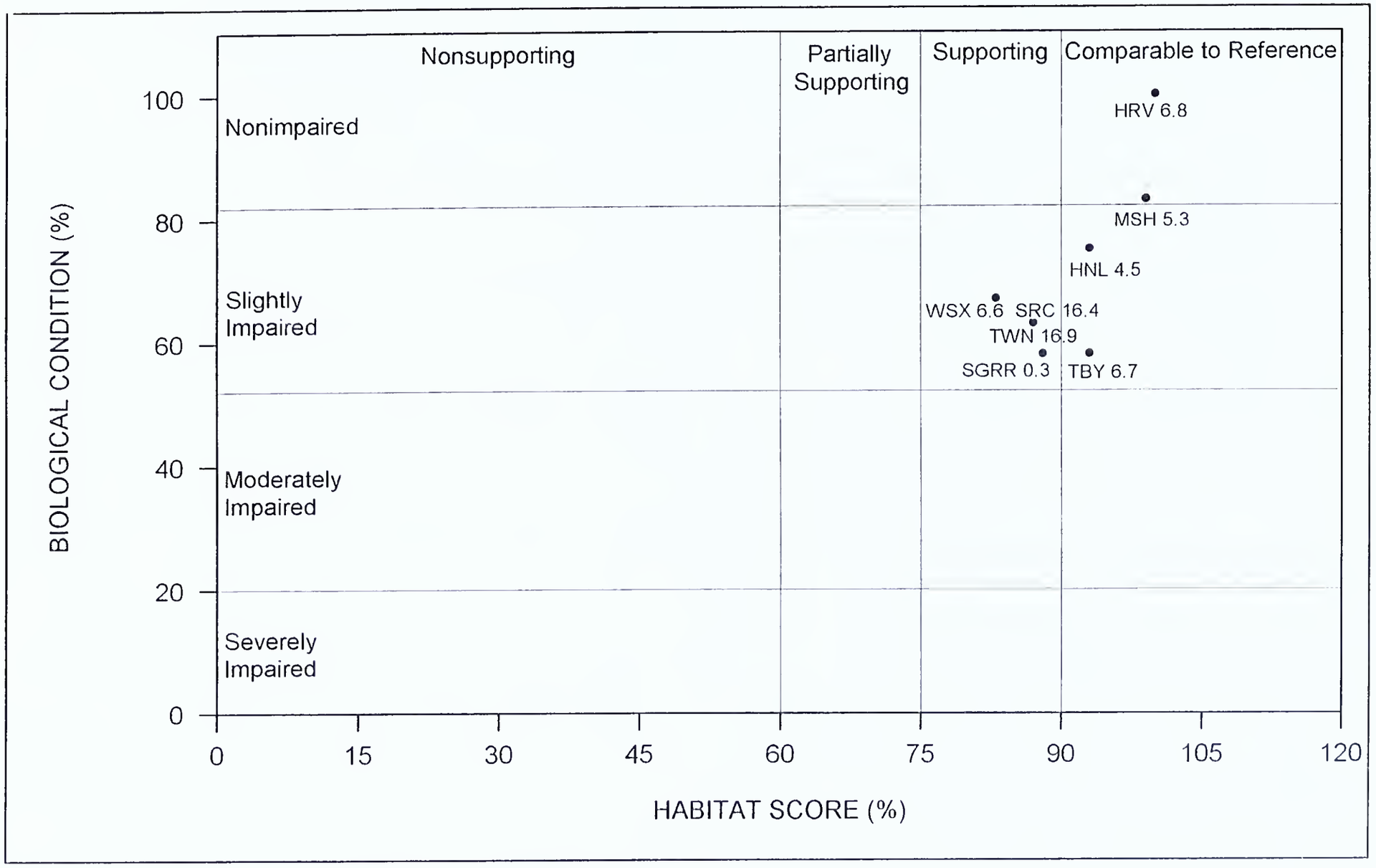


Figure 10. Relationship Between Habitat Condition and Biological Scores in Reference Category 60.1

streams are located in rural areas of the Middle Susquehanna Subbasin, and support healthy macroinvertebrate populations.

Reference Category 60.2

The larger streams on the Northern Appalachian Plateau Ecoregion were placed in reference category 60.2. The reference site for this region was Wysox Creek at the mouth. The conditions of the streams in this reference category were variable with Habitat Assessment Scores ranging from 71 to 136 (Table 10). The high habitat score at Mehoopany (MHO 0.1) indicates that the habitat conditions at this site are better (scored high) than the reference site; however, biological conditions are poorer than the reference site. Most of the category 60.2 stations had habitat conditions that were comparable to their reference site. Figure 11 illustrates the relationship between habitat conditions and the biological scores for streams in this reference category. Most of these streams support non-impaired or slightly impaired macroinvertebrate populations. Some of the sites had low biological scores that were the result of a lack of quality habitat. Generally, reduced habitat quality in Northern Appalachian Plateau and Uplands Ecoregion streams tended to be associated with degraded stream channel morphology and riparian and bank structure conditions. Many of these streams are located in rural areas of the Middle Susquehanna Subbasin, and support healthy biological communities.

Table 10. Biological and Habitat Assessment Scores of Sampling Sites and Percent Comparability With Reference Site WSX 0.2 in Ecoregion 60.2

Stream Name	Sampling Site (1)	Reference Category (2)	Biological		Habitat	
			Total Score	Percent Compatibility	Total Score	Percent Compatibility
Wysox Cr.	**WSX 0.2**	**60.2**	**48**	**100**	**119**	**100**
Towanda Cr.	TWN 0.1	60.2	44	92	119	100
Tunkhannock Cr.	TNK 11.3	60.2	44	92	122	102
Bowman Cr.	BOW 0.1	60.2	40	83	110	92
Meshoppen Cr.	MSH 0.1	60.2	38	79	104	87
Wyalusing Cr.	WYL 16.2	60.2	36	75	80	67
Wyalusing Cr.	WYL 0.4	60.2	34	71	117	98
Sugar Cr.	SRC 0.8	60.2	32	67	97	81
Mehoopany Cr.	MHO 0.1	60.2	30	63	136	114
Tunkhannock Cr.	TNK 0.3	60.2	24	50	71	60

(1) Numbers indicate the location of the sample station with respect to miles above the stream's mouth.
(2) Reference Category 60.2—large streams in the Northern Appalachian Plateau and Uplands Ecoregion.

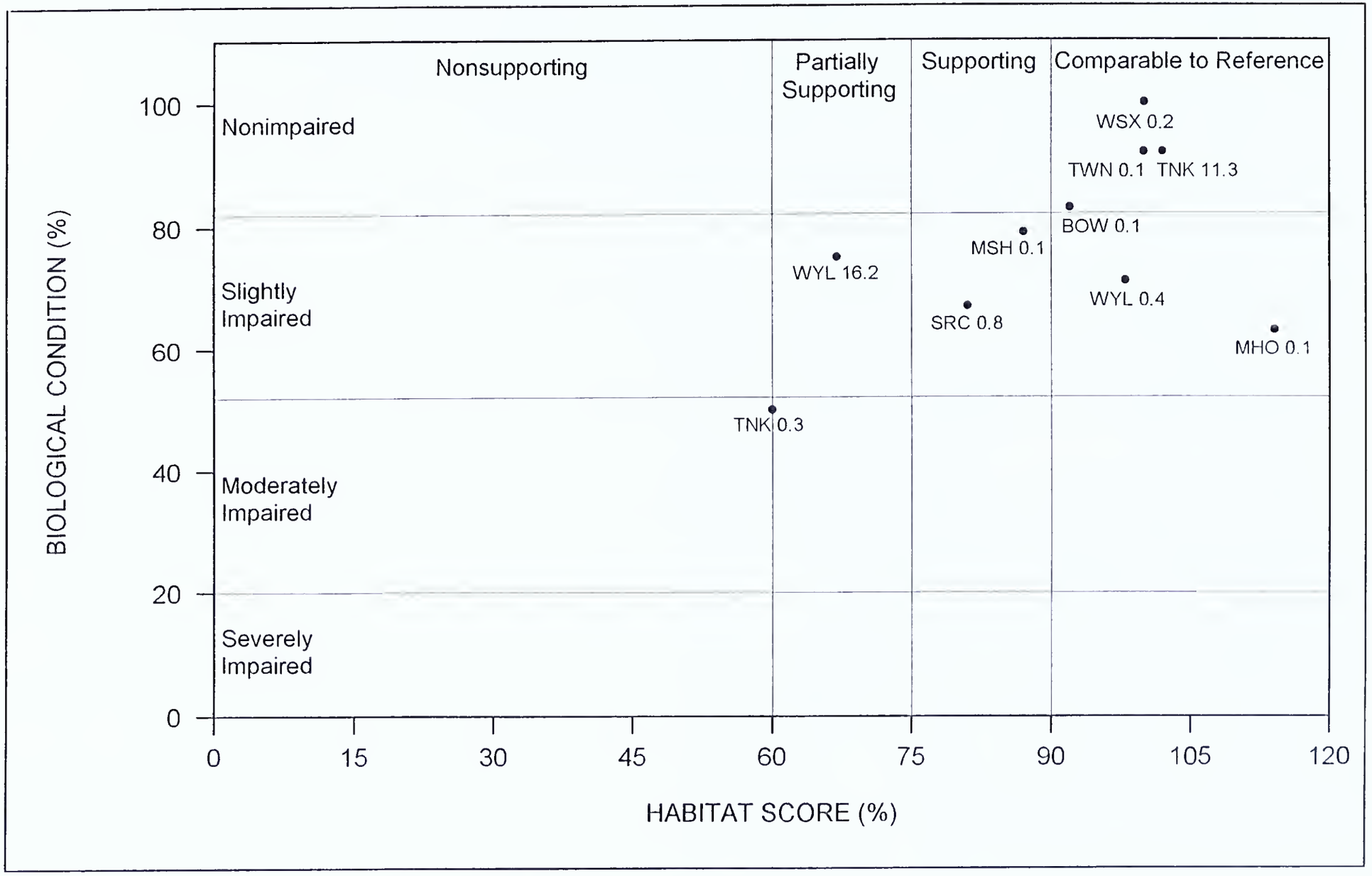


Figure 11. Relationship Between Habitat Condition and Biological Scores in Reference Category 60.2

Reference Category 62

The North Central Appalachians Ecoregion constitutes only a small part of the Middle Susquehanna Subbasin. Reference category 62 encompasses the north central Appalachian mountains; however, it is not well represented in the Middle Susquehanna Subbasin. Only two sites were sampled in this ecoregion. Bowmans Creek, at stream mile 12.5, was used as the reference site for this ecoregion. The habitat and biological assessment scores are shown in Table 11. Both streams had suitable habitats that supported non-impaired biological communities. The relationship between habitat conditions and biological scores can be seen in Figure 12. The graph indicates these two streams have suitable habitat conditions that support non-impaired biological communities. Both of these sites were assigned to the T1 water quality category, which is characterized by pristine watersheds and exceptional water quality.

Table 11. Biological and Habitat Assessment Scores of Sampling Sites and Percent Comparability With Reference Site BOW 12.5 in Ecoregion 62

Stream Name	Sampling Site (1)	Reference Category (2)	Biological		Habitat	
			Total Score	Percent Compatibility	Total Score	Percent Compatibility
Bowman Cr.	**BOW 12.5**	**62**	**48**	**100**	**136**	**100**
Mehoopany Cr.	MHO 6.5	62	46	96	115	85

(1) Numbers indicate the location of the sample station with respect to miles above the stream's mouth.
(2) Reference Category 62—streams in the North Central Appalachians Ecoregion. Reference site in bold.

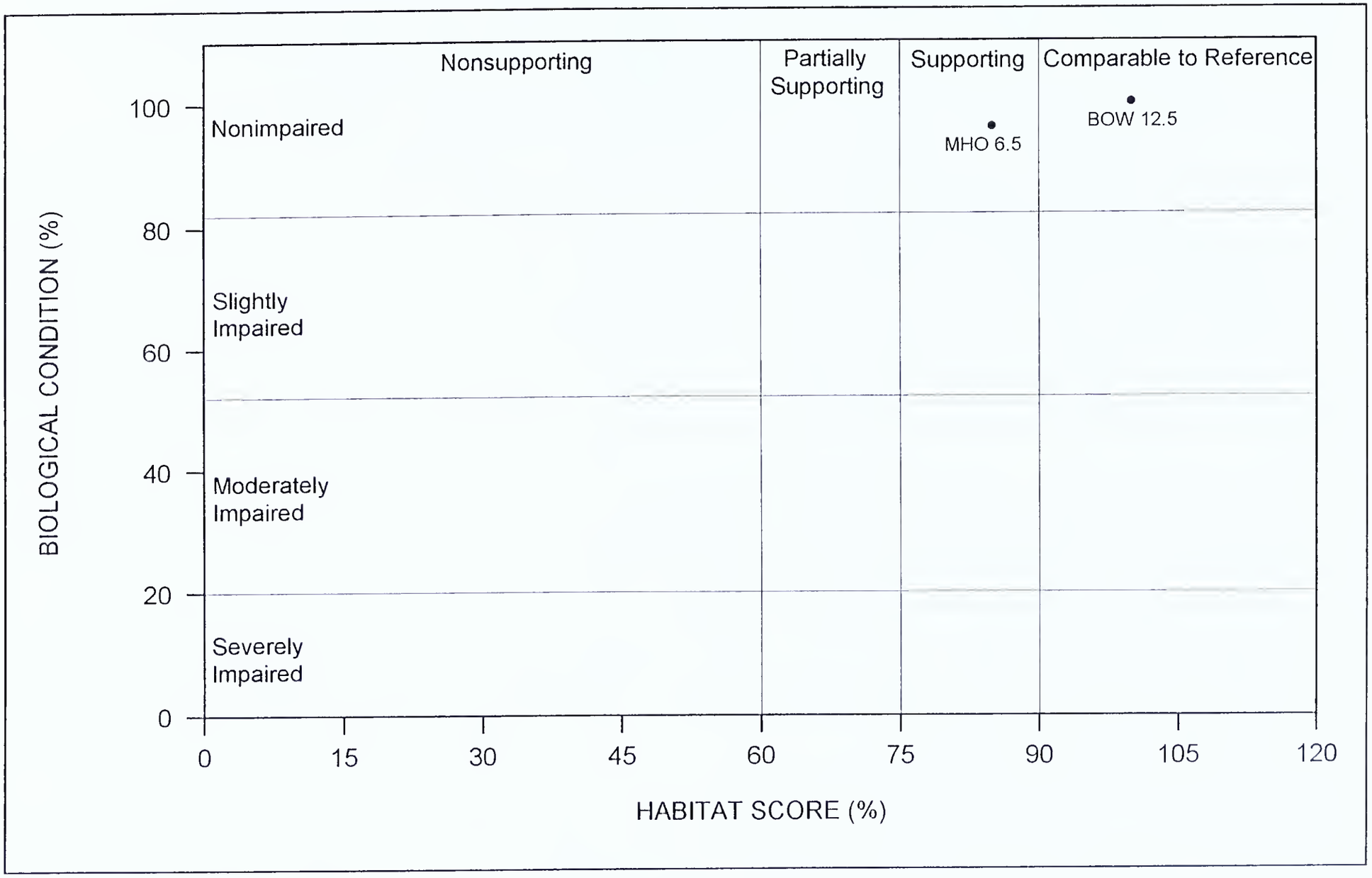


Figure 12. Relationship Between Habitat Condition and Biological Scores in Reference Catetory 62

Reference Category 67.1

Small streams in the Central Appalachian Ridges and Valleys Ecoregion were assigned to reference category 67.1. The reference site for this category of streams was Roaring Creek at stream mile 10.7. These streams show a wide variety of habitat conditions and biological scores (Table 12). Figure 13 shows that two different curves are apparent when habitat condition scores are plotted against biological condition scores for streams in this ecoregion. The first curve formatted by TBY 0.2, BLK 9.3, WBRR 2.4 and LWWP 0.1 is basically linear and reflects the condition where the quality of the habitat is limiting the macroinvertebrate population. The other curve formed by the remainder of the sites suggests some of these streams have such poor water quality that they will not support a good macroinvertebrate population, even if suitable habitat is present. Seven sites in reference category 67.1 had non-impaired biological communities, eight sites had slightly impaired communities, five sites were moderately impaired, and four sites were severely impaired. The majority of the stations in this ecoregion had habitat conditions comparable to reference conditions. However, the habitat conditions of a substantial number of stations were designated as being non-supportive of aquatic life. Habitat degradation in the streams of this ecoregion was largely due to poor primary habitat conditions, mainly in the form of adversely impacted bottom substrate/cover conditions and embeddedness. Degraded water quality and habitat conditions were primarily due to sewage treatment plant discharges and heavy deposits of fine materials and/or iron hydroxide precipitate (yellow boy) associated with coal mining activities in this ecoregion.

Table 12. Biological and Habitat Assessment Scores of Sampling Sites and Percent Comparability With Reference Site RRC 10.7 in Ecoregion 67.1

Stream Name	Sampling Site (1)	Reference Category (2)	Biological		Habitat	
			Total Score	Percent Compatibility	Total Score	Percent Compatibility
Roaring Cr.	**RRC 10.7**	**67.1**	**48**	**100**	**136**	**100**
Little Wapwallopen Cr.	LWWP 0.1	67.1	46	96	124	91
Shickshinny Cr.	SHK 0.1	67.1	46	96	124	91
Briar Cr.	BRR 0.4	67.1	44	92	128	94
East Br. Briar Cr.	EBRR 4.7	67.1	42	88	131	96
Little Wapwallopen Cr.	LWWP 6.7	67.1	40	83	128	94
Lackawanna River	LWR 36.0	67.1	40	83	131	96
Little Fishing Cr.	LFSH 0.1	67.1	38	79	122	90
Harveys Cr.	HRV 0.1	67.1	36	75	133	98
Hunlock Cr.	HNL 0.2	67.1	36	75	142	104
South Br. Roaring Cr.	SBRC 0.5	67.1	36	75	144	106
West Br. Briar Cr.	WBRR 2.4	67.1	34	71	98	72
Shickshinny Cr.	SHK 4.5	67.1	28	58	133	98
Wapwallopen Cr.	WWP 6.4	67.1	28	58	138	101
Wapwallopen Cr.	WWP 0.1	67.1	28	58	143	105
Mahoning Cr.	MAH 0.8	67.1	22	46	134	98
Roaring Brook	RRB 0.1	67.1	18	38	129	95
Black Cr.	BLK 0.1	67.1	18	38	136	100
Black Cr.	BLK 9.3	67.1	12	25	56	41
Toby Cr.	TBY 0.2	67.1	10	21	51	38
Leggetts Cr.	LGT 0.1	67.1	8	17	110	81
Newport Cr.	NPT 0.1	67.1	0	0	93	59
Solomon Cr.	SOL 0.9	67.1	0	0	80	59
Nanticoke Cr.	NTK 0.4	67.1	0	0	99	73

(1) Numbers indicate the location of the sample station with respect to miles above the stream's mouth.
(2) Reference Category 67.1—small streams in the Central Appalachian Ridges and Valleys Ecoregion.

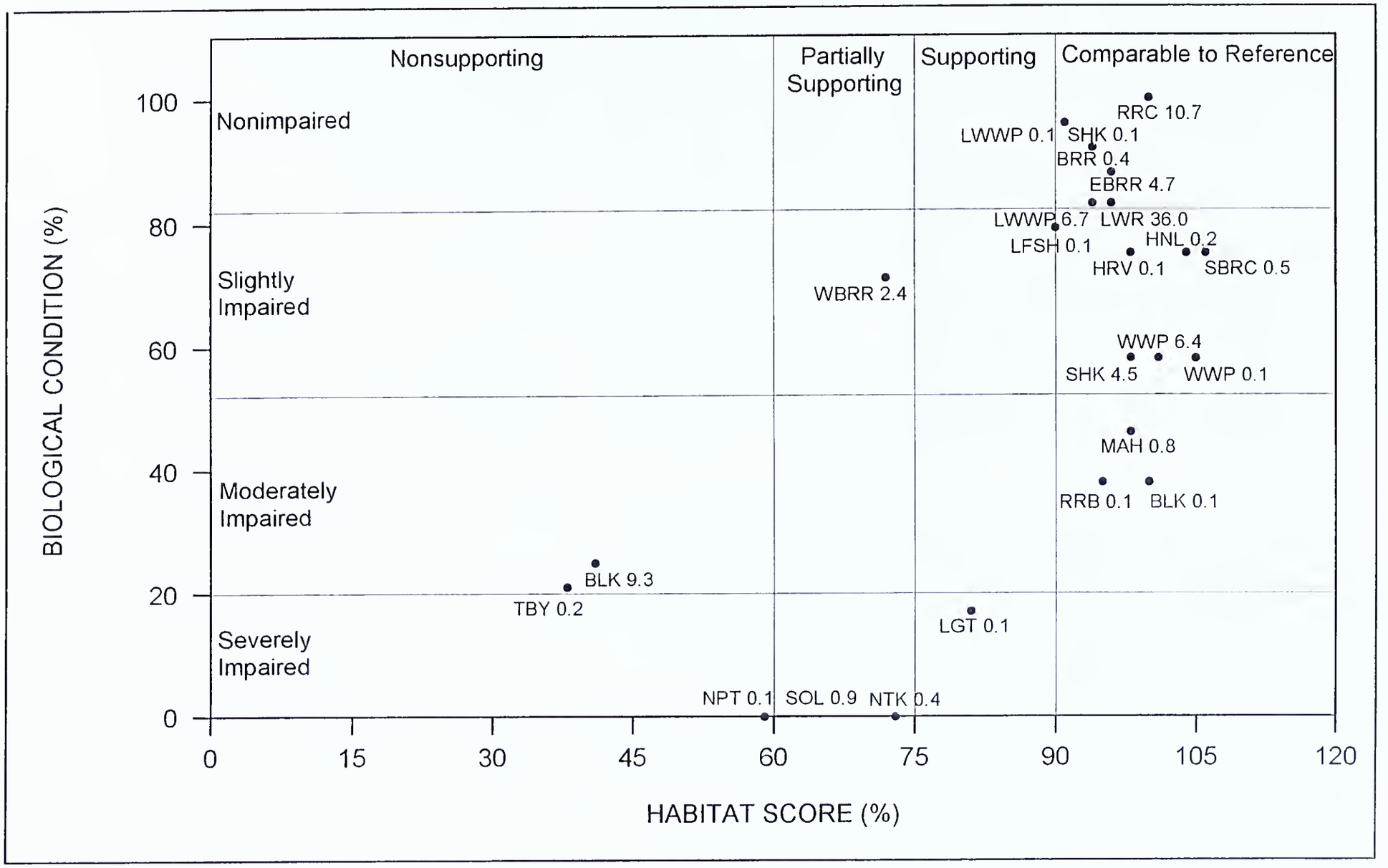


Figure 13. Relationship Between Habitat Condition and Biological Score in Reference Category 67.1

Reference Category 67.2

The larger streams in the Central Appalachian Ridges and Valleys Ecoregion were incorporated in reference category 67.2. The reference site for these streams was Fishing Creek at stream mile 15.6. Figure 14 illustrates the biological communities in these streams are either very healthy or severely impaired. Habitat Assessment Scores for the 12 sites in this category ranged from 61 to 155 (Table 13). Three sites in this reference category were non-impaired, two slightly impaired, two moderately impaired, and five were severely impaired. One half of the stations in this ecoregion had habitat conditions comparable to reference conditions. However, the habitat conditions of 25 percent of the stations in this reference category were designated as being non-supportive of aquatic life. Habitat degradation in the streams of this ecoregion was largely due to poor primary habitat conditions, mainly in the form of adversely impacted bottom substrate/cover conditions and embeddedness. All of the streams in this reference category that have impaired biological populations are degraded by AMD. Degraded habitat conditions were usually due to heavy deposits of fine materials and/or iron hydroxide precipitate (yellow boy) associated with the coal mining activities within this ecoregion. Figures 15 and 16 show the habitat and biological assessment ratings, respectively, for the tributary sites.

Middle Susquehanna River

The Middle Susquehanna River is influenced by many different ecoregions throughout the reach from Ulster, Pa., to Sunbury, Pa. The influence of so many ecoregions results in a unique type of environment in the river that may not be found on most of the tributary streams. For this reason, one reference site was selected to represent the entire Middle Susquehanna River. That reference site was Susquehanna River (SUSQ 207), near Falls, Pa. The biological community in the main stem varies significantly due to habitat and water quality conditions (Figure 17). Poor water quality, due to AMD and the effects of urbanization, results in slightly to moderately impaired macroinvertebrate communities in much of the river. Habitat conditions in the main stem indicate the river is capable of supporting a non-impaired to slightly impaired biological community in the absence of water quality degradation. Figures 18 and 19 show the locations of the sampling site and the habitat and biological assessment ratings, respectively, for the river sites.

Figure 20 provides a summary of habitat and biological conditions of the Middle Susquehanna Subbasin sampling sites. Habitat conditions at 83 percent of the sites were rated as either excellent or supporting, and biological conditions at 71 percent of the sites were either non-impaired or slightly impaired.

Relationships Among Habitat, Biological Conditions, and Water Quality

Water quality had a significant impact on the biological communities of the tributary sites in the Middle Susquehanna Subbasin. Water quality categories and habitat and biological conditions of the tributary and river sites are listed in Table 14.

As seen in Table 14, most of the streams in the T1 water quality category maintain healthy macroinvertebrate populations. Non-impaired to slightly impaired biological populations exist in most of the T2 and T3 water quality sites. Streams in the T4 and T5 water quality category, characterized by high nutrient concentrations and low alkalinity, support slightly to moderately impaired biological communities. The biological communities in the T6, T7, and T8 streams were severely impaired due to AMD. Biological communities at these sites will not improve unless water quality first improves.

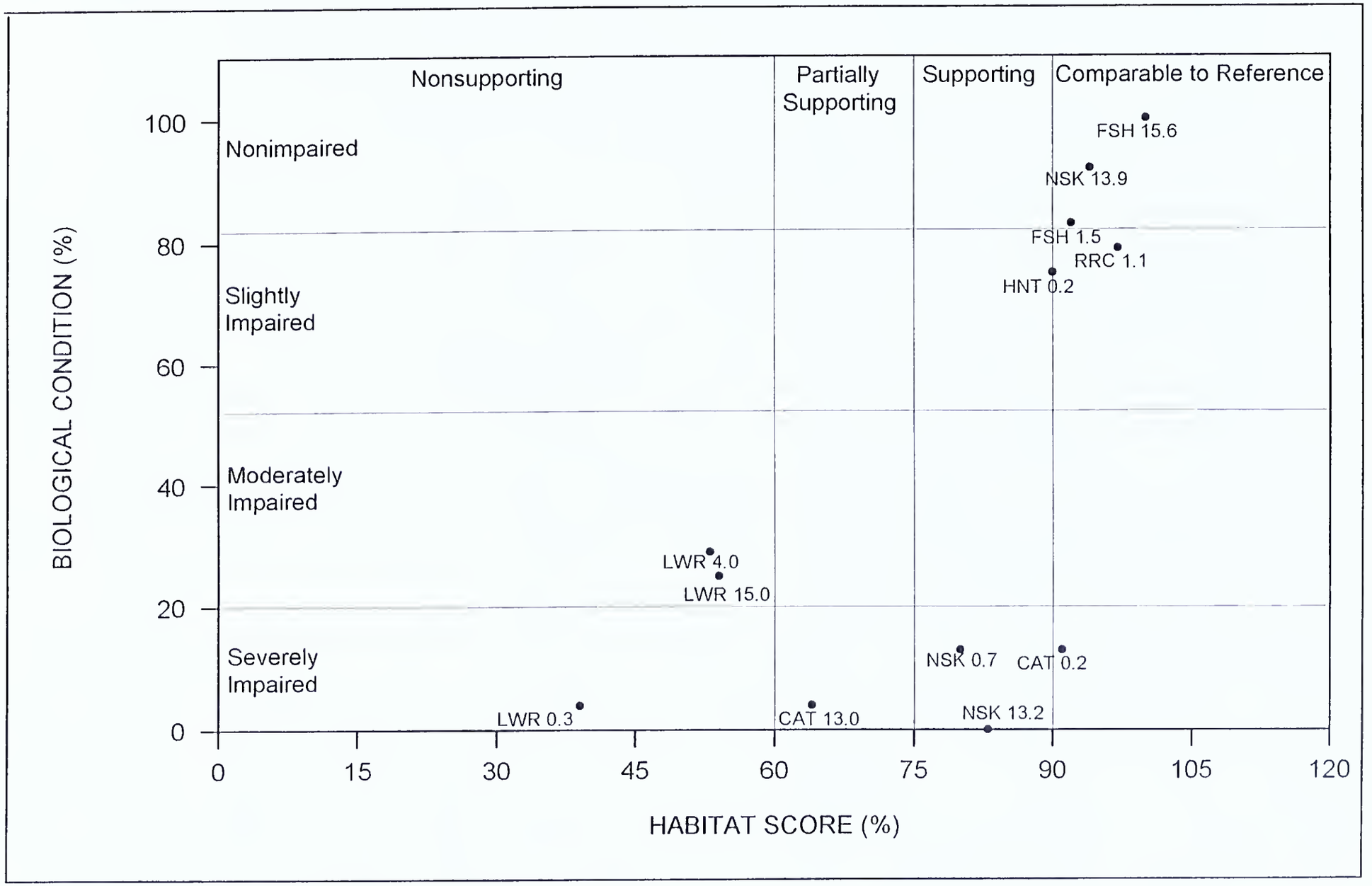


Figure 14. Relationship Between Habitat Condition and Biological Scores in Reference Category 67.2

Table 13. Biological and Habitat Assessment Scores of Sampling Sites and Percent Comparability With Reference Site FSH 15.6 in Ecoregion 67.2

Stream Name	Sampling Site (1)	Reference Category (2)	Biological		Habitat	
			Total Score	Percent Compatibility	Total Score	Percent Compatibility
Fishing Cr.	**FSH 15.6**	**67.2**	**48**	**100**	**155**	**100**
Nescopeck Cr.	NSK 13.9	67.2	44	92	146	94
Fishing Cr.	FSH 1.5	67.2	40	83	142	92
Roaring Cr.	RRC 1.1	67.2	38	79	151	97
Huntington Cr.	HNT 0.2	67.2	36	75	140	90
Lackawanna River	LWR 4.0	67.2	14	29	83	53
Lackawanna River	LWR 15.0	67.2	12	25	84	54
Nescopeck Cr.	NSK 0.7	67.2	6	13	124	80
Catawissa Cr.	CAT 13.0	67.2	6	13	141	91
Lackawanna River	LWR 0.3	67.2	2	4	61	39
Catawissa Cr.	CAT 0.2	67.2	2	4	99	64
Nescopeck Cr.	NSK 13.2	67.2	0	0	129	83

(1) Numbers indicate the location of the sample station with respect to miles above the stream's mouth.
(2) Reference Category 67.2—large streams in the Central Appalachian Ridges and Valleys Ecoregion.

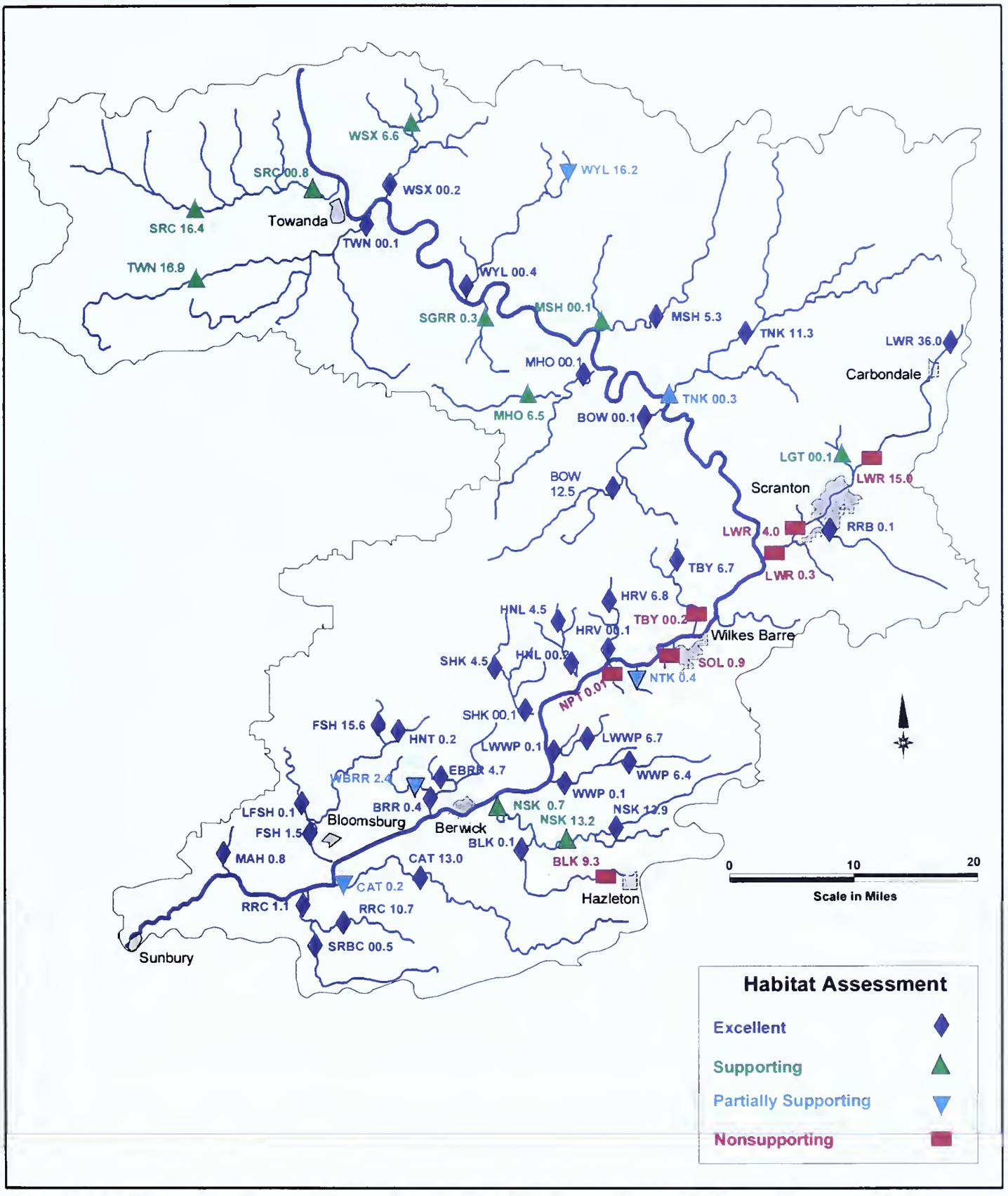


Figure 15. Habitat Assessment Ratings for the Middle Susquehanna Tributary Sampling Sites

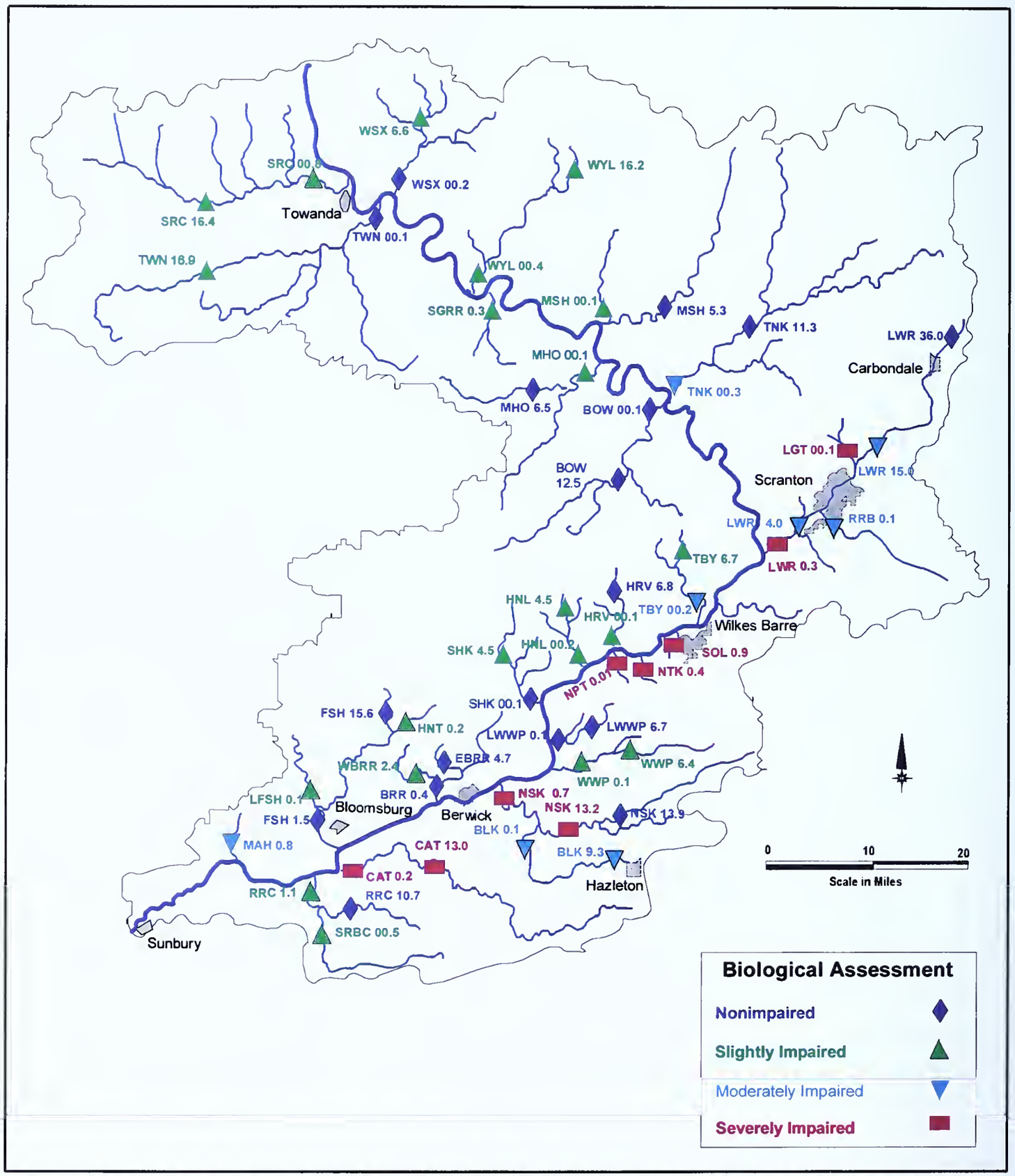


Figure 16. Biological Assessment Ratings for the Middle Susquehanna Tributary Sampling Sites

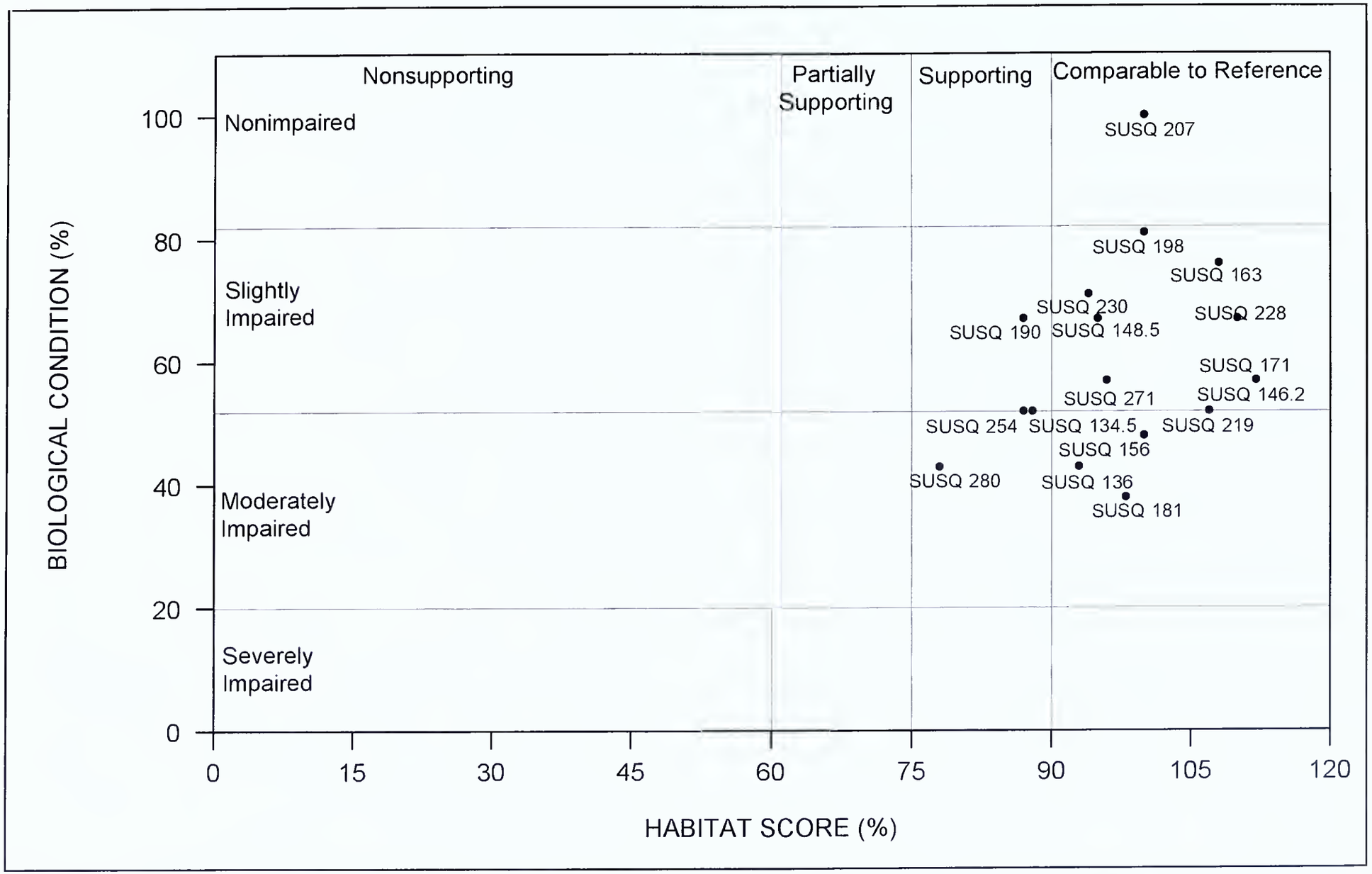


Figure 17. Relationship Between Habitat Condition and Biological Scores for the Middle Susquehanna River Sampling Sites

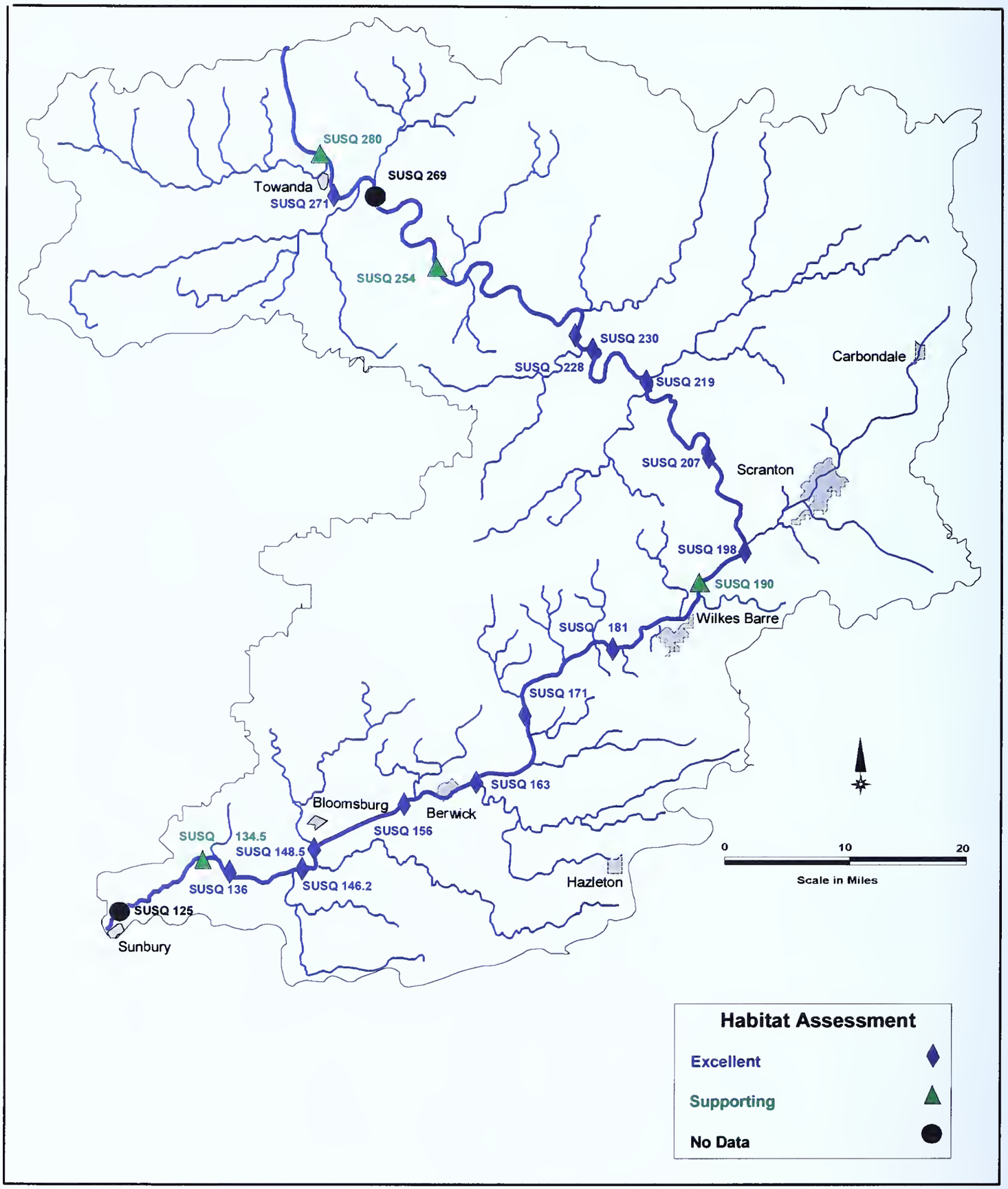


Figure 18. Habitat Assessment Ratings for the Middle Susquehanna River Sampling Sites

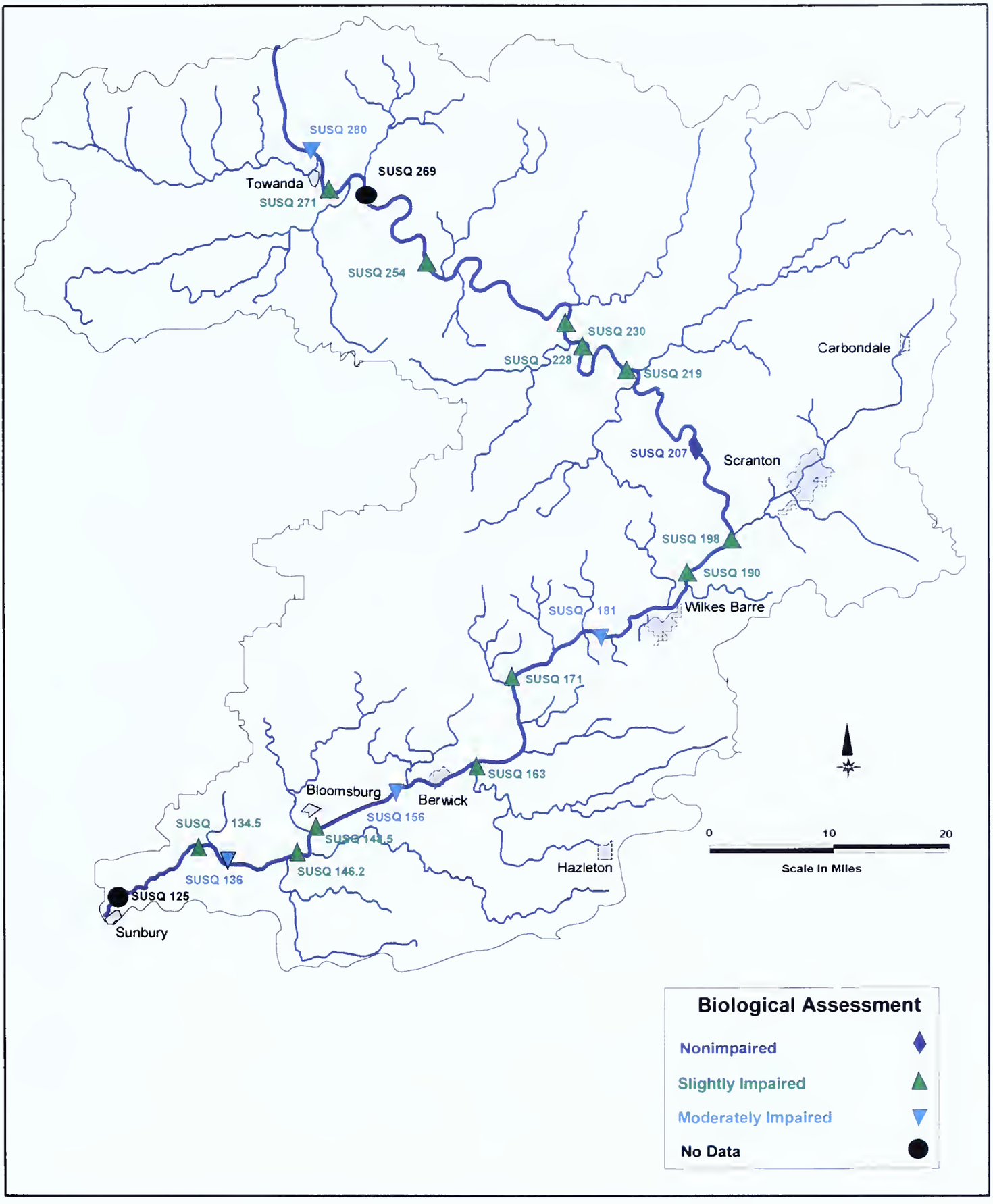


Figure 19. Biological Assessment Ratings for the Middle Susquehanna River Sampling Sites

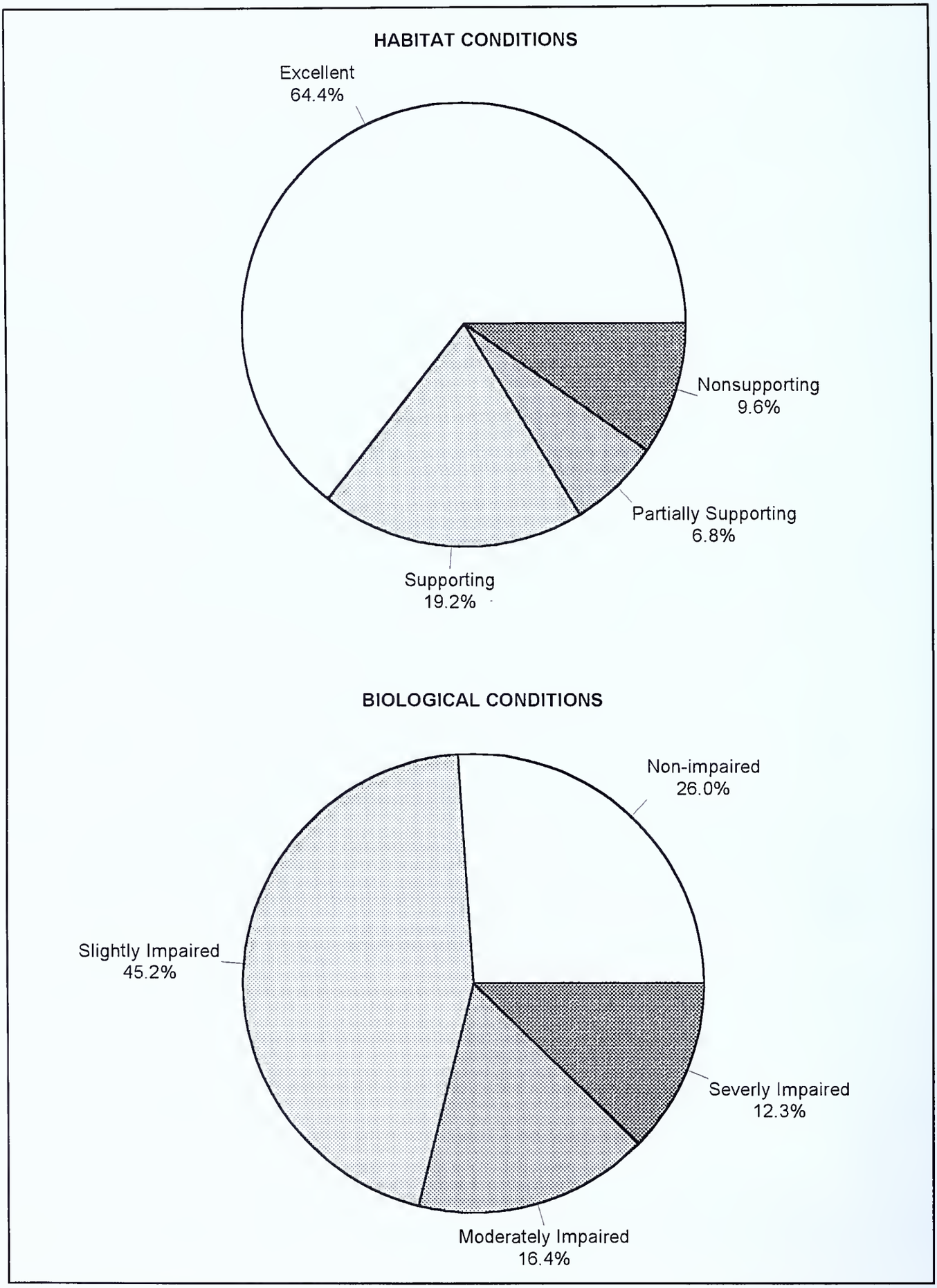


Figure 20. Summary of Habitat and Biological Conditions of Middle Susquehanna Subbasin Sampling Sites

Table 14. Summary of Water Quality Category and Habitat and Biological Assessment Ratings by Reference Categories

Sampling Site	Ref. Cat.	WQ Cat..	Hab. Assess. Rating	Bio. Assess Rating
HRV 6.8	60.1	T2	Excellent	Non-impaired
MSH 5.3	60.1	T3	Excellent	Non-impaired
HNL 4.5	60.1	T2	Excellent	Slightly
WSX 6.6	60.1	T2	Supporting	Slightly
SRC 16.4	60.1	T4	Supporting	Slightly
TWN 16.9	60.1	T3	Supporting	Slightly
TBY 6.7	60.1	T4	Excellent	Slightly
SGRR 0.3	60.1	T3	Supporting	Slightly
WSX 00.2	60.2	T3	Excellent	Non-impaired
TNK 11.3	60.2	T2	Excellent	Non-impaired
TWN 00.1	60.2	T3	Excellent	Non-impaired
BOW 00.1	60.2	T3	Excellent	Non-impaired
MSH 00.1	60.2	T3	Supporting	Slightly
WYL 16.2	60.2	T3	Part. Support	Slightly
WYL 00.4	60.2	T5	Excellent	Slightly
SRC 00.8	60.2	T4	Supporting	Slightly
MHO 00.1	60.2	T1	Excellent	Slightly
TNK 00.3	60.2	T3	Part. Support	Moderately
BOW 12.5	62	T1	Excellent	Non-impaired
MHO 6.5	62	T1	Supporting	Non-impaired
RRC 10.7	67.1	T1	Excellent	Non-impaired
LWWP 0.1	67.1	T1	Excellent	Non-impaired
SHK 00.1	67.1	T1	Excellent	Non-impaired
BRR 0.4	67.1	T3	Excellent	Non-impaired
EBRR 4.7	67.1	T2	Excellent	Non-impaired
LWR 36.0	67.1	T3	Excellent	Non-impaired
LWWP 6.7	67.1	T2	Excellent	Non-impaired
LFSH 0.1	67.1	T3	Excellent	Slightly
SRBC 0.5	67.1	T2	Excellent	Slightly
HNL 00.2	67.1	T2	Excellent	Slightly
HRV 00.1	67.1	T2	Excellent	Slightly
WBRR 2.4	67.1	T3	Part. Support	Slightly
WWP 0.1	67.1	T2	Excellent	Slightly
WWP 6.4	67.1	T5	Excellent	Slightly
SHK 4.5	67.1	T2	Excellent	Slightly
MAH 0.8	67.1	T4	Excellent	Moderately
BLK 0.1	67.1	T5	Excellent	Moderately
RRB 00.1	67.1	T4	Excellent	Moderately
BLK 9.3	67.1	T2	Nonsupport.	Moderately
TBY 00.2	67.1	T5	Nonsupport.	Moderately
LGT 00.1	67.1	T4	Supporting	Severely
NTK 0.4	67.1	T7	Part. Support	Severely
NPT 0.1	67.1	T7	Nonsupport.	Severely
SOL 0.9	67.1	T7	Nonsupport.	Severely
FSH 15.6	67.2	T2	Excellent	Non-impaired
NSK 13.9	67.2	T2	Excellent	Non-impaired
FSH 1.5	67.2	T2	Excellent	Non-impaired
RRC 1.1	67.2	T2	Excellent	Slightly
HNT 0.2	67.2	T2	Excellent	Slightly
LWR 4.0	67.2	T4	Nonsupport.	Moderately
LWR 15.0	67.2	T4	Nonsupport.	Moderately
CAT 13.0	67.2	T6	Excellent	Severely
NSK 0.7	67.2	T8	Supporting	Severely
CAT 0.2	67.2	T6	Part. Support.	Severely
LWR 00.3	67.2	T7	Nonsupport.	Severely
NSK 13.2	67.2	T8	Supporting	Severely
SUSQ 207	River	R1	Excellent	Non-impaired
SUSQ 198	River	R1	Excellent	Slightly
SUSQ 163	River	R3	Excellent	Slightly
SUSQ 230	River	R1	Excellent	Slightly
SUSQ 228	River	R2	Excellent	Slightly
SUSQ 148.5	River	R1	Excellent	Slightly
SUSQ 190	River	R3	Supporting	Slightly
SUSQ 146.2	River	R3	Excellent	Slightly
SUSQ 171	River	R3	Excellent	Slightly
SUSQ 271	River	R1	Excellent	Slightly
SUSQ 219	River	R2	Excellent	Slightly
SUSQ 134.5	River	R3	Supporting	Slightly
SUSQ 254	River	R1	Supporting	Slightly
SUSQ 156	River	R3	Excellent	Moderately
SUSQ 136	River	R1	Excellent	Moderately
SUSQ 280	River	R3	Supporting	Moderately
SUSQ 181	River	R3	Excellent	Moderately
SUSQ 125	River	R1		
SUSQ 269	River	R1		

SUMMARY

Water quality, biological, and stream and riparian habitat data were collected from selected sites in the Middle Susquehanna Subbasin during summer low flow conditions in July and August 1993. One sample was collected at each site. The data were used to provide a qualitative assessment of the water quality and ecological integrity of 19 Susquehanna River and 56 tributary sites between Ulster and Sunbury, Pennsylvania.

Cluster analysis of the tributary and Susquehanna River water quality data suggested the presence of eight tributary water quality categories and three Susquehanna River categories. These categories were designated as T1 through T8 for the tributary sites and R1 through R3 for the river sites.

The water quality characteristics of categories T1, T2, and T3 sites were related to the proportion of forest and agricultural land use within the watershed and the degree to which these land uses impact water quality. The T1 sites represented the most pristine watersheds, while the T3 sites represented watersheds with the greatest proportion of agricultural land use. The T4 and T5 stations were generally impacted by more urban/suburban land uses, while the T6, T7, and T8 water quality categories represented various AMD impacted streams. Sampling sites on the river were influenced by the chemical quality of nearby tributaries, which may change the chemical characteristics of a short reach along the river. The R1 sites were mostly located upstream, and the R3 sites were located downstream of the Lackawanna River.

Habitat conditions at each sampling station were assessed using a slightly modified version of the habitat assessment procedure outlined by Plafkin and others (1989). The smaller streams in the Northern Appalachian Plateau and Uplands Ecoregion (Reference Category 60.1) generally had suitable habitat conditions and good macroinvertebrate populations. Habitat conditions of the larger waterways in this ecoregion (reference category 60.2) were somewhat more variable. Although most of the category 60.2 stations had habitat conditions that were comparable to their reference site, this group of sites had the lowest median habitat assessment score. Most of the streams in reference category 60.2 were located in rural areas of the subbasin and supported non-impaired or slightly impaired macroinvertebrate populations. Some of the sites had lower biological scores that were the result of a lack of quality habitat. Generally, reduced habitat quality in Northern Appalachian Plateau and Uplands Ecoregion streams tended to be associated with degraded stream channel morphology and riparian and bank structure conditions.

The North Central Appalachians Ecoregion (reference category 62) constitutes only a small part of the Middle Susquehanna Subbasin. Reference category 62 encompasses the north central Appalachian mountains; however, it is not well represented in the Middle Susquehanna Subbasin. Only two sites were sampled in this ecoregion. These two streams had suitable habitat conditions that supported non-impaired biological communities.

Stream habitat conditions in the Central Appalachian Ridges and Valleys Ecoregion (reference categories 67.1 and 67.2) were quite variable. Small streams in this ecoregion were assigned to reference category 67.1. Streams in this category showed a variety of habitat conditions and biological scores. Some of the streams reflected conditions where the quality of habitat was limiting the macroinvertebrate population. Other streams had such poor water quality that they did not support a good macroinvertebrate population, even if suitable habitat was present. The larger streams were incorporated in reference category 67.2. The biological communities in these streams were either very healthy or severely impaired. All of the streams in this reference category had impaired biological populations due to AMD.

The biological community in the Middle Susquehanna River varied significantly due to habitat and water quality conditions. Poor water quality that was the result of AMD and the effects

of urbanization resulted in slightly to moderately impaired macroinvertebrate communities in much of the Susquehanna River. Habitat conditions indicated that the river was capable of supporting a non-impaired to slightly impaired biological community in the absence of water quality degradation.

Water quality had a significant impact on the biological communities in the Middle Susquehanna Subbasin. Streams in the T1 water quality category were located in relatively pristine areas of the subbasin, and most of them maintained healthy macroinvertebrate populations. Non-impaired to slightly impaired biological populations existed at most of the T2 and T3 water quality sites. These watersheds contained some agricultural land and some sparse population areas. Streams in the T4 and T5 water quality category were impacted by sewage treatment plants and other forms of urbanization. These streams were characterized by high nutrient concentrations and low alkalinity that resulted in slightly to moderately impaired biological communities. Biological communities in the T6, T7, and T8 streams were severely impaired due to AMD. Biological communities at these sites will not improve unless water quality improves.

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Appendix A
Water Quality Data for the Middle Susquehanna River and Tributary Sampling Sites

Sampling Site	Date	Time	Drain. Area	Flow		Water Temp.	pH			Conductivity		Alkalinity			Residue			
							Field	Lab	DO	Field	Lab	Total	CO3	Acid	Total	Diss.	Non Fil	
	mddyy	hhmm	sq. mi.	cfs	rem	Deg. C	Stan. Units		mg/l	µ ohms/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	rem
BLK0.1	72193	1445	61.7	16.5		22.5	6.71		8.7	403		4		6	238	221		
BLK9.3	72193	1615	17.4	0.2		23.1	6.30		7.8	183		12		8	106	82		
BOW0.1	72293	1650	120	9.3		24.0	9.25		8.5	117		12	3	0	66	51		
BOW12.5	72293	1810	39	4.0		22.0	7.60		7.8	42		6		1	28	20		
BRR0.4	72293	1015	33	4.0		18.7	7.68		9.4	252		72		2	148	130		
CAT0.2	80993	1530	153	37.2		22.0	4.80	4.70	8.9	199	170	2		10	138	132	6	
CAT13.0	80993	1300	120	25.8		20.8	4.60	4.60	9.5	258	219	2		20	192	187	5	
EBRR4.7	72293	1330	7.32	0.9		18.8	7.35		10.0	113		16		4	84	72		
FSH1.5	81093	1115	385	26.2		21.8	6.49	6.80	7.4	147	124	24		8	96	92	4	
FSH15.6	81093	1500	117	10.3		18.8	6.25	6.70	9.8	97	84	10		4	92	92	2	L
HNL0.2	72093	830	32.5	2.3		18.4	7.15		7.4	133		20		4	104	71		
HNL4.5	72093	1015	3.14	0.5	a	18.0	7.20		8.6	284		22		4				
HNT0.2	81093	1335	114	3.6		21.4	6.70	6.80	9.1	108	93	16		4	60	54	6	
HRV0.1	71993	1315	46.3	6.2		19.3	7.79		7.5	182		28		2	112	104		
HRV6.8	71993	1630	21.3	2.5		19.1	7.30		7.9	131		20		6	88	68		
LFS110.1	81093	935	68.1	1.6		19.3	7.10	7.20	7.9	230	195	54		6	142	136	6	
LGT0.1	80993	1758	18.5	1.7		22.4	8.70	8.30	7.9	552	553	48	4	0	364	364	2	L
LWR0.3	81093	1237	347.6	123.4		20.4	6.65	6.70	9.1	917	881	60		36	354	339	15	
LWR15.0	80993	1730	143	21.9		23.5	8.25	7.60	10.4	470	477	20		0	386	386	2	L
LWR36.0	80993	1548	47	1.8	g	24.3	8.10	7.40	8.8	95	92	26		1	92	92	2	L
LWR3.0	81093	1130	332	45.0	g	23.5	8.45	8.00	10.9	461	450	38	1	0	844	835	9	
LWWP0.1	72093	1700	39.5	1.1		23.9	6.85		7.2	101		12		4	72	61		
LWWP6.7	72093	1530	20.9	0.5	a	26.9	7.20		7.7	158		18		2	88	81		
MAH0.8	81293	945	31.6	8.6		19.6	7.85	7.80	8.1	561	485	102		2	308	294	14	
MHO0.1	72293	1713	123	3.2		19.0	6.90		7.7	90		20		2	40	32		
MHO6.5	72193	1141	71.9	2.9		20.7	6.75		9.1	44		6		4	50	48		
MSH0.1	72193	1716	114	7.0		25.5	8.85		10.2	158		41	5	0	102	94		
MSH5.3	72193	1537	45	2.8		23.4	7.65		8.0	133		40		2	106	95		
NPT0.1	81193	1154	14	4.2		18.2	6.65	6.50	7.5	1,834	1,758	92		120	1,758	1,693	65	

Sampling Site	Date	Time	Drain. Area	Flow		Water Temp.	pH			Conductivity		Alkalinity			Residue			
							Field	Lab	DO	Field	Lab	Total	CO3	Acid	Total	Diss.	Non Fil	
	mddyy	hhmm	sq. mi.	cfs	rem	Deg C	Stan. Units		mg/l	μ ohms/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	rem
NSK0.7	72193	1815	174	61.4		24.6	4.51		8.5	658		0		38	532	518		
NSK13.2	72193	1330	84.4	9.0	e	19.1	4.49		9.5	790		0		60	1,166	639		
NSK13.9	72193	1245	98.6	10.0	e	20.6	7.01		7.8	114		12		4	72	63		
NTK0.4	81193	1053	7.57	0.0		18.8	6.60	6.70	6.7	1,171	1,156	62		46	954	933	21	
RRB0.1	81093	900	56.5	0.5	a	21.2	7.85	7.70	5.9	388	391	74		2	256	254	2	
RRC1.1	81193	1150	87.9	10.7		19.9	7.45	6.90	8.8	140	127	24		2	70	64	6	
RRC10.7	81193	1320	34.7	5.8		20.4	7.75	6.80	9.1	105	90	22		2	52	49	3	
SBRC0.5	81193	1550	36.6	3.7		21.0	7.59	7.10	9.1	190	165	28		2	82	68	14	
SGRR0.3	72193	935	57.1	1.0		18.7	7.55		9.5	171		44		2	86	86		
SlIK0.1	72093	1315	35	2.1		21.8	7.41		8.8	87		8		2	74	74		
SlIK4.5	72093	1145	6.75	0.5	a	21.8	7.15		7.2	155		26		4	82	80		
SOL0.9	81193	908	18.2	19.6		16.1	6.05	6.40	5.0	1,476	1,399	88		228	1,264	1,209	55	
SRC0.8	71993	1335	188	2.2	g	22.9	7.95	7.00	8.8	315	284	86		2	176	174	2	
SRC16.4	71993	1603	93.7	2.2		22.9	7.80	7.00	8.9	302	296	90		5	204	195	9	
SUSQ125.0	81293	1415	11,301	1605	e	24.1	8.90	7.60	9.8	496	465	62	8	0	328	315	13	
SUSQ134.5	81293	1155	11,253	1598	e	21.8	7.70	7.60	4.9	504	471	78		4	304	286	18	
SUSQ136.0	81193	1700	11,220	1590	g	25.7	9.28	8.70		524	445	84	12	0	296	286	10	
SUSQ146.2	81193	940	10,942	1554	e	23.1	8.00	7.40	7.4	567	489	66		2	358	347	11	
SUSQ148.5	81093	1730	10,553	1499	e	26.4	8.80	9.10	14.3	526	451	66	12	0	344	327	17	
SUSQ156.0	80993	1045	10,532	1496	e	22.8	7.79	7.70	8.7	577	488	70		6	376	361	15	
SUSQ163.0	72293	815	10,308	1552	e	23.8	7.35		7.5	543		80		6	332	317		
SUSQ171.0	72093	1430	10,189	1504	e	26.0	7.30		7.1	548		72		8	296	292		
SUSQ181.0	71993	1445	10,052	1453	e	23.4	7.20		7.1	537		80		12	360	352		
SUSQ190.0	71993	1100	9,960	1410	g	23.6	7.20		5.8	524		78		12	314	306		
SUSQ198.0	80993	1253	9,539	1488	e	25.9	8.55	7.10	10.8	375	370	80	4	0	264	255	9	
SUSQ207.0	80993	1022	9,442	1473	e	24.0	8.20	8.20	8.7	376	367	80	4	0	270	270	2	L
SUSQ219.0	72293	1519	8,879	1222	e	25.5	8.60		9.0	360		80	4	0	232	220		
SUSQ228.0	72193	1930	8,854	1218	e	26.5	8.85		9.3	376		84	8	0	242	228		
SUSQ230.0	72193	2030	8,720	1200	g	26.5	8.75		10.0	380		82	7	0	230	215		

Sampling Site	Date	Time	Drain. Area	Flow		Water Temp.	pH			Conductivity		Alkalinity			Residue			
							Field	Lab	DO	Field	Lab	Total	CO3	Acid	Total	Diss.	Non Fil	
	mddyy	hhmm	sq. mi.	cfs	rem	Deg C	Stan. Units		mg/l	µ ohms/cm		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	rem
SUSQ254.0	72193	818	8,244	1138	e	24.0	8.55		8.3	422		81	2	0	232	214		
SUSQ269.0	72093	2028	8,090	1120	e	25.5	9.10		10.6	350		80	10	0	234	219		
SUSQ271.0	72093	1807	7,797	1090	g	26.7	9.05		11.6	373		80	8	0	252	237		
SUSQ280.0	71993	1030	7,590	1061	g	23.5	7.60	6.90	7.9	419	379	80		4	236	221	15	
TBY0.2	81093	1650	36.5	5.3		21.3	6.60	6.80	4.8	331	327	36		18	246	215	31	
TBY6.7	81093	1514	9.8	0.2		20.3	7.60	7.40	8.7	314	315	54		1	214	207	7	
TNK0.3	72293	1401	413.0	41.0	g	24.0	8.40		9.0	177		44	1	0	118	111		
TNK11.3	72293	950	261.0	27.8		20.5	7.40		8.8	158		40		4	106	100		
TWN0.1	72093	1937	278.0	31.0	g	26.0	7.70		8.4	158		34		2	104	98		
TWN16.9	71993	1821	72.0	3.3		22.7	8.65	7.00	9.9	277	249	54	3	0	158	151	7	
WBRR2.4	72293	1145	11.5	1.8		21.2	8.80		12.8	263		76	4	0	156	133		
WSX0.2	72093	1600	101.0	2.6		25.0	7.00		8.2	169		40		6	100	95		
WSX6.6	72093	1422	38.4	0.4		22.5	6.75		9.4	144		26		6	104	99		
WWP0.1	72193	830	53.2	11.9		18.9	7.00		8.3	188		12		2	102	94		
WWP6.4	72193	1000	33.5	6.5		19.4	7.05		8.8	285		12		4	146	132		
WYL0.4	72093	1034	219.0	11.0		22.0	7.30	6.70	9.2	519	507	40		8	334	329	5	
WYL16.2	72093	824	149.0	6.8		20.3	7.35	6.70	8.2	139	134	36		4	82	82	2	L

Remarks

a Very little flow in stream channel, approximated at 0.5 cfs

e Flow estimated using drainage area ration method with known flow a nearby sties

g Flow determined from stream gage

L Reporting limit— value is less than result shown

Sampling Site	Date	Time	Ammonia				Nitrite as N				Nitrate as N				Kjeldahl Nitrogen				Total Nitrogen			
			Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total	
	mddyy	hhmm	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem
BLK0.1	72193	1445	0.02	L	0.04		0.010		0.016		3.15		3.61		0.54		0.73		3.7		4.4	
BLK9.3	72193	1615	0.16		0.17		0.012		0.018		0.49		0.49		0.30		0.39		0.8		0.9	
BOW0.1	72293	1650	0.02	L	0.02	L	0.006		0.008		0.54		0.54		0.20	L	0.20	L	0.7	L	0.7	L
BOW12.5	72293	1810	0.02	L	0.02		0.004	L	0.010		0.19		0.19		0.20	L	0.20	L	0.4	L	0.4	L
BRR0.4	72293	1015	0.02	L	0.02	L	0.010		0.012		1.31		1.31		0.21		0.29		1.5		1.6	
CAT0.2	80993	1530	0.02	L	0.02		0.004	L	0.004	L	0.64		0.66		0.20	L	0.20	L	0.8	L	0.9	L
CAT13.0	80993	1300	0.02		0.02		0.004	L	0.004	L	0.59		0.59		0.20	L	0.20	L	0.8	L	0.8	L
EBRR4.7	72293	1330	0.02	L	0.02	L	0.004		0.006		1.10		1.11		0.02	L	0.25		1.1	L	1.4	
FSH1.5	81093	1115	.0.20		0.04		0.006		0.006		1.07		1.07		0.20	L	0.20	L	1.3	L	1.3	L
FSH15.6	81093	1500	0.02	L	0.02	L	0.004		0.004		1.43		1.43		0.20	L	0.46		1.6	L	1.9	
HNL0.2	72093	830	0.02	L	0.02	L	0.004	L	0.004	L	0.61		0.61		0.20	L	0.20	L	0.8	L	0.8	L
HNL4.5	72093	1015	0.02	L	0.02	L	0.004	L	0.004	L	0.59		0.59		0.22		0.34		0.8	L	0.9	L
HNT0.2	81093	1335	0.02	L	0.02		0.004	L	0.004	L	0.33		0.33		0.20	L	0.20		0.5	L	0.5	L
HRV0.1	71993	1315	0.02	L	0.02	L	0.004		0.004		0.79		0.81		0.21		0.26		1.0		1.1	
HRV6.8	71993	1630	0.02	L	0.02		0.006		0.006		0.50		0.50		0.20	L	0.34		0.7	L	0.8	
LFSH0.1	81093	935	0.02	L	0.03		0.006		0.006		0.72		0.72		0.20	L	0.20	L	0.9	L	0.9	L
LGT0.1	80993	1758	0.02	L	0.03		0.010		0.012		6.76		6.76		0.73	10	0.70	10	7.5		7.5	
LWR0.3	81093	1237	0.46	10	0.45	10	0.028		0.028		2.87		3.12		0.62		0.62		3.5		3.8	
LWR15.0	80993	1730	0.07		0.07		0.012		0.012		5.80		6.04		0.52		0.83		6.3		6.9	
LWR36.0	80993	1548	0.04		0.05		0.004	L	0.004	L	0.04	L	0.04	L	0.21		0.27		0.3		0.3	L
LWR3.0	81093	1130	0.04		0.04		0.062		0.062		8.65		8.89		0.75		1.28		9.5		10.2	
LWWP0.1	72093	1700	0.02	L	0.02	L	0.004	L	0.006		0.35		0.37		0.20	L	0.20	L	0.6	L	0.6	L
LWWP6.7	72093	1530	0.02	L	0.02	L	0.004	L	0.006		0.26		0.26		0.22		0.27		0.5	L	0.5	
MAH0.8	81293	945	0.02	L	0.05		0.026		0.026		2.04		2.04		0.28		0.42		2.3		2.5	
MHO0.1	72293	1713	0.02	L	0.02	L	0.004	L	0.006		0.32		0.32		0.20	L	0.20	L	0.5	L	0.5	L
MHO6.5	72193	1141	0.02	L	0.02	L	0.004	L	0.004	L	0.10		0.15		0.20	L	0.20	L	0.3	L	0.4	L
MSH0.1	72193	1716	0.02	L	0.02	L	0.004	L	0.006		0.10		0.10		0.20		0.23		0.3	L	0.3	
MSH5.3	72193	1537	0.03		0.03		0.004	L	0.012		0.14		0.14		0.24		0.45		0.4	L	0.6	
NPT0.1	81193	1154	1.45		1.51		0.006		0.006		0.08		0.08		1.67		1.78		1.8		1.9	
NSK0.7	72193	1815	0.25		0.25		0.004		0.008		1.58		1.58		0.42		0.44		2.0		2.0	

Sampling Site	Date	Time	Ammonia				Nitrite as N				Nitrate as N				Kjeldahl Nitrogen				Total Nitrogen			
			Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total	
	mddyy	hhmm	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem
NSK13.2	72193	1330	0.20		0.22		0.004	L	0.010		0.43		0.43		0.20	L	2.26		0.6	L	2.7	
NSK13.9	72193	1245	0.02	L	0.02	L	0.006		0.010		0.83		0.83		0.20	L	0.22		1.0	L	1.1	
NTK0.4	81193	1053	0.43		0.44		0.010		0.010		0.14		0.14		0.88		0.88		1.0		1.0	
RRB0.1	81093	900	0.02		0.06		0.006		0.006		0.04		0.09		0.34		0.51		0.4		0.6	
RRC1.1	81193	1150	0.02	L	0.04		0.022		0.022		1.83		1.83		0.26		0.35		2.1		2.2	
RRC10.7	81193	1320	0.02	L	0.03		0.008		0.008		1.38		1.38		0.20	L	0.20		1.6	L	1.6	
SBRC0.5	81193	1550	0.02	L	0.10		0.128		0.162		2.38		2.61		0.66	10	0.52	10	3.2		3.3	
SGRR0.3	72193	935	0.02	L	0.02		0.004	L	0.004		0.04	L	0.13		0.20	L	0.20	L	0.2	L	0.3	L
SHK0.1	72093	1315	0.02	L	0.02	L	0.004	L	0.004	L	0.53		0.53		0.22		0.26		0.8	L	0.8	L
SHK4.5	72093	1145	0.02	L	0.03		0.004		0.004		0.44		0.46		0.20	L	0.25		0.6	L	0.7	
SOL0.9	81193	908	1.50		1.53		0.010	10	0.004	10	0.04	L	0.04	L	1.78		1.78		1.8	L	1.8	L
SRC0.8	71993	1335	0.02	L	0.03		0.004		0.004		0.04	L	0.19		0.36		0.36		0.4	L	0.6	
SRC16.4	71993	1603	0.02	L	0.07		0.006		0.016		0.13		0.14		0.23		0.40		0.4		0.6	
SUSQ125.0	81293	1415	0.02	L	0.02	L	0.004	L	0.004		0.04	L	0.04	L	0.27		0.70		0.3	L	0.7	L
SUSQ134.5	81293	1155	0.14		0.25		0.088		0.088		0.53		0.55		0.51		0.96		1.1		1.6	
SUSQ136.0	81193	1700	0.02	L	0.02	L	0.004		0.004		0.04	L	0.04	L	0.28		0.66		0.3	L	0.7	L
SUSQ146.2	81193	940	0.02	L	0.08		0.006		0.006		0.15		0.17		0.31		0.75		0.5		0.9	
SUSQ148.5	81093	1730	0.02	L	0.03		0.006		0.006		0.04	L	0.04	L	0.38		0.83		0.4	L	0.9	L
SUSQ156.0	80993	1045	0.02		0.10		0.004		0.004		0.37		0.39		0.25		0.64		0.6		1.0	
SUSQ163.0	72293	815	0.02	L	0.02		0.006		0.012		0.54		0.56		0.21		0.31		0.8		0.9	
SUSQ171.0	72093	1430	0.05		0.05		0.006		0.008		0.59		0.59		0.53		0.58		1.1		1.2	
SUSQ181.0	71993	1445	0.06		0.11		0.008		0.008		0.59		0.59		0.47		0.63		1.1		1.2	
SUSQ190.0	71993	1100	0.02	L	0.07		0.014	10	0.008	10	0.58	10	0.50	10	0.39		0.51		1.0		1.0	
SUSQ198.0	80993	1253	0.03		0.11		0.004		0.006		0.04	L	0.04	L	0.48		1.04		0.5	L	1.1	L
SUSQ207.0	80993	1022	0.15		0.19		0.004		0.006		0.04	L	0.04	L	0.52		1.14		0.6	L	1.2	L
SUSQ219.0	72293	1519	0.02	L	0.02	L	0.008		0.012		0.10		0.10		0.36		0.66		0.5		0.8	
SUSQ228.0	72193	1930	0.12		0.13		0.004		0.010		0.06		0.06		0.66		0.93		0.7		1.0	
SUSQ230.0	72193	2030	0.02	L	0.02	L	0.004	L	0.008		0.06		0.06		0.34		0.64		0.4	L	0.7	
SUSQ254.0	72193	818	0.02	L	0.02	L	0.004	L	0.004	L	0.04	L	0.04		0.29		0.70		0.3	L	0.7	L
SUSQ269.0	72093	2028	0.02	L	0.02	L	0.004	L	0.004		0.04	L	0.04		0.27		0.55		0.3	L	0.6	

Sampling Site	Date	Time	Ammonia				Nitrite as N				Nitrate as N				Kjeldahl Nitrogen				Total Nitrogen			
			Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total		Dissolved		Total	
	mddyy	hhmm	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem
SUSQ271.0	72093	1807	0.02	L	0.02	L	0.004	L	0.004		0.04	L	0.04		0.27		0.81		0.3	L	0.9	
SUSQ280.0	71993	1030	0.02	L	0.21		0.004	L	0.008		0.04	L	0.04	L	0.34		0.92		0.4	L	1.0	L
TBY0.2	81093	1650	0.76		0.80		0.264		0.288		3.28		3.28		1.33		1.90		4.9		5.5	
TBY6.7	81093	1514	0.02	L	0.03		0.004		0.006		0.70		0.72		0.24		0.24		0.9		1.0	
TNK0.3	72293	1401	0.02	L	0.02	L	0.006		0.010		0.32		0.32		0.20	L	0.23		0.5	L	0.6	
TNK11.3	72293	950	0.02	L	0.02	L	0.004		0.008		0.45		0.45		0.20	L	0.20	L	0.7	L	0.7	L
TWN0.1	72093	1937	0.02	L	0.02	L	0.004	L	0.004		0.00	L	0.28		0.23		0.27		0.2	L	0.6	
TWN16.9	71993	1821	0.02	L	0.07		0.006		0.024		0.15		0.15		0.27		0.28		0.4		0.5	
WBRR2.4	72293	1145	0.02	L	0.02	L	0.012		0.016		1.67		1.67		0.21		0.21		1.9		1.9	
WSX0.2	72093	1600	0.02	L	0.02	L	0.004	L	0.004		0.41		0.44		0.20	L	0.20	L	0.6	L	0.6	L
WSX6.6	72093	1422	0.02	L	0.02	L	0.008		0.012		0.69		0.74		0.21		0.22		0.9		1.0	
WWP0.1	72193	830	0.02	L	0.02	L	0.004		0.006		1.52		1.53		0.20	L	0.20	L	1.7	L	1.7	L
WWP6.4	72193	1000	0.02	L	0.02		0.004		0.006		1.33		1.33		0.38		0.47		1.7		1.8	
WYL0.4	72093	1034	0.02	L	0.09		0.034		0.040		10.10		10.10		0.44		0.47		10.6		10.6	
WYL16.2	72093	824	0.05		0.05		0.008		0.010		0.10		0.21		0.20		0.22		0.3		0.4	

Remarks

10 Lab analysis indicates dissolved greater than total

L Reporting limit— value is less than result shown

Sampling Site	Date	Time	Phosphorus as P				Ortho-Phos as P				TOC		TN	TP
			Dissolved		Total		Dissolved		Total		Total		YIELD	YIELD
	mddyy	hhmm	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	lbs/ac/yr	lbs/ac/yr
BLK0.1	72193	1445	0.51		0.064		0.018		0.162		5.8		3.581	0.4192
BLK9.3	72193	1615	0.07		0.013		0.002	L	0.019		3.1		0.027	0.0021
BOW0.1	72293	1650	0.02	L	0.020		0.010			i	1.6		0.155	0.0024
BOW12.5	72293	1810	0.02	L	0.009		0.002		0.002		1.1		0.094	0.0031
BRR0.4	72293	1015	0.05		0.015		0.002	L	0.014		1.7		0.604	0.0187
CAT0.2	80993	1530	0.02	L	0.002	L	0.002	L	0.002		1.1		0.569	0.0075
CAT13.0	80993	1300	0.02		0.002	L	0.002	L	0.002		1.3		0.457	0.0132
EBRR4.7	72293	1330	0.04		0.014		0.005		0.014		1.0		0.533	0.0156
FSH1.5	81093	1115	0.02		0.002		0.002	L	0.002		1.3		0.246	0.0042
FSH15.6	81093	1500	0.06		0.018		0.020		0.022		1.2		0.514	0.0163
HNL0.2	72093	830	0.06		0.031		0.016			i	1.9		0.152	0.0128
HNL4.5	72093	1015	0.07		0.027		0.018		0.002		2.4		0.456	0.0343
HNT0.2	81093	1335	0.03		0.030		0.020		0.002		2.0		0.051	0.0029
HRV0.1	71993	1315	0.13		0.106		0.091		0.080		2.2		0.444	0.0537
HRV6.8	71993	1630	0.08		0.027		0.012		0.003		2.5		0.308	0.0291
LFSH0.1	81093	935	0.02		0.002	L	0.002	L	0.002		1.9		0.058	0.0014
LGT0.1	80993	1758	1.38		1.290		1.140		1.160		4.2		2.148	0.3967
LWR0.3	81093	1237	0.19		0.031		0.022		0.018		2.0		4.112	0.2073
LWR15.0	80993	1730	0.92		0.798		0.684		0.700		3.9		3.240	0.4332
LWR36.0	80993	1548	0.06		0.022		0.013		0.021		3.6		4.263	0.5000
LWR3.0	81093	1130	1.20		1.200		1.110		1.150		5.8		0.034	0.0071
LWWP0.1	72093	1700	0.02	L	0.009		0.002	L	0.002		1.6		0.040	0.0008
LWWP6.7	72093	1530	0.02		0.013		0.012		0.002		3.3		0.039	0.0015
MAH0.8	81293	945	0.24		0.196		0.147		0.170		3.3		2.091	0.2019
MHO0.1	72293	1713	0.02	L	0.012		0.002	L	0.002		1.7		0.034	0.0008
MHO6.5	72193	1141	0.04		0.048		0.037		0.003		1.1		0.032	0.0050
MSH0.1	72193	1716	0.03		0.038		0.024		0.005		2.8		0.064	0.0057
MSH5.3	72193	1537	0.06		0.045		0.030		0.014		3.3		0.113	0.0113
NPT0.1	81193	1154	0.02	L	0.002	L	0.003		0.004		1.4		1.719	0.0092
NSK0.7	72193	1815	0.05		0.015		0.002	L	0.006		1.7		2.200	0.0543

Sampling Site	Date	Time	Phosphorus as P				Ortho-Phos as P				TOC		TN	TP
			Dissolved		Total		Dissolved		Total		Total		YIELD	YIELD
	mddyy	hhmm	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	lbs/ac/yr	lbs/ac/yr
NSK13.2	72193	1330	0.37		0.011		0.005		0.054		1.0	L	0.885	0.1213
NSK13.9	72193	1245	0.06		0.052		0.041		0.031		2.1		0.332	0.0188
NTK0.4	81193	1053	0.04		0.002	L	0.002	L	0.002		2.1		0.007	0.0003
RRB0.1	81093	900	0.07		0.002	L	0.019		0.019		3.9		0.016	0.0019
RRC1.1	81193	1150	0.10		0.084		0.052		0.062		2.9		0.824	0.0374
RRC10.7	81193	1320	0.03		0.029		0.010		0.002		2.3		0.813	0.0154
SBRC0.5	81193	1550	0.36		0.309		0.256		0.306		3.2		1.010	0.1105
SGRR0.3	72193	935	0.02		0.025		0.002		0.002		2.4		0.012	0.0010
SHK0.1	72093	1315	0.05		0.029		0.015		0.002		2.2		0.147	0.0093
SHK4.5	72093	1145	0.06		0.028		0.017		0.002		2.5		0.163	0.0137
SOL0.9	81193	908	0.02	L	0.020	L	0.010		0.016		1.0	L	5.971	0.0331
SRC0.8	71993	1335	0.04		0.048		0.002	L	0.025		3.3		0.020	0.0015
SRC16.4	71993	1603	0.13		0.120		0.082		0.106		3.1		0.039	0.0092
SUSQ125.0	81293	1415	0.07		0.024		0.010		0.002		4.7		0.316	0.0306
SUSQ134.5	81293	1155	0.25		0.132		0.078		0.107		5.1		0.698	0.1091
SUSQ136.0	81193	1700	0.10		0.028		0.010		0.002		5.1		0.298	0.0436
SUSQ146.2	81193	940	0.07		0.018		0.010		0.002		4.2		0.404	0.0306
SUSQ148.5	81093	1730	0.12		0.011		0.009		0.002		4.6		0.374	0.0524
SUSQ156.0	80993	1045	0.06		0.002	L	0.002	L	0.002		3.6		0.451	0.0262
SUSQ163.0	72293	815	0.06		0.012		0.002	L		i	2.8		0.408	0.0278
SUSQ171.0	72093	1430	0.07		0.017		0.007		0.002		3.3		0.534	0.0318
SUSQ181.0	71993	1445	0.08		0.017		0.012		0.005		3.0		0.546	0.0356
SUSQ190.0	71993	1100	0.07		0.023		0.011		0.002		3.5		0.443	0.0305
SUSQ198.0	80993	1253	0.12		0.029		0.015		0.018		6.3		0.511	0.0575
SUSQ207.0	80993	1022	0.20		0.130		0.101		0.110		5.4		0.559	0.0959
SUSQ219.0	72293	1519	0.09		0.037		0.022		0.002		5.0		0.327	0.0381
SUSQ228.0	72193	1930	0.09		0.042		0.011		0.002		5.4		0.423	0.0381
SUSQ230.0	72193	2030	0.05		0.016		0.002	L	0.002		4.2		0.300	0.0212
SUSQ254.0	72193	818	0.06		0.017		0.002	L		i	4.3		0.315	0.0255
SUSQ269.0	72093	2028	0.06		0.038		0.024		0.002		4.7		0.253	0.0255

Sampling Site	Date	Time	Phosphorus as P				Ortho-Phos as P				TOC		TN	TP
			Dissolved		Total		Dissolved		Total		Total		YIELD	YIELD
	mddyy	hhmm	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	mg/l	rem	lbs/ac/yr	lbs/ac/yr
SUSQ271.0	72093	1807	0.12		0.053		0.037		0.016		4.9		0.367	0.0516
SUSQ280.0	71993	1030	0.10		0.038		0.003		0.080		3.3		0.407	0.0430
TBY0.2	81093	1650	0.74		0.415		0.329		0.340		3.9		2.422	0.3278
TBY6.7	81093	1514	0.15		0.147		0.080		0.097		2.1		0.073	0.0114
TNK0.3	72293	1401	0.03		0.046		0.034		0.004		2.4		0.171	0.0092
TNK11.3	72293	950	0.02		0.016		0.002	L	0.002		2.0		0.183	0.0065
TWN0.1	72093	1937	0.03		0.047		0.019		0.008		2.0		0.190	0.0103
TWN16.9	71993	1821	0.09		0.086		0.055			i	2.4		0.063	0.0125
WBRR2.4	72293	1145	0.06		0.023		0.011		0.023		1.6		0.926	0.0293
WSX0.2	72093	1600	0.02		0.028		0.021		0.005		1.7		0.043	0.0016
WSX6.6	72093	1422	0.02		0.040		0.026		0.002		1.7		0.031	0.0006
WWP0.1	72193	830	0.23		0.183		0.173		0.164		1.7		1.124	0.1580
WWP6.4	72193	1000	0.49		0.481		0.457		0.458		2.9		1.075	0.2916
WYL0.4	72093	1034	0.08		0.079		0.050		0.049		2.0		1.632	0.0123
WYL16.2	72093	824	0.04		0.025		0.002	L	0.016		1.9		0.062	0.0056

Remarks

i Insufficient sample for analysis

L Reporting limit— value is less than result shown

Sampling Site	Date	Time	Hardness Total		Alkalinity as HCO3	Calcium Total	Magnesium Total	Sodium Total	Potassium Total	Chlorides Total	Sulfate Total		Water Type
	mddyy	hhmm	mg/l	rem	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	rem	
BLK0.1	72193	1445	48		5	8.2	4.8	48.0	3.47	59	43		NaCl
BLK9.3	72193	1615	33		15	7.6	2.4	15.3	1.34	28	11		NaCl
BOW0.1	72293	1650	41		15	12.0	1.7	4.0	0.97	6	10	L	CaHCO3
BOW12.5	72293	1810	10	L	7	3.3	0.8	1.6	0.51	2	10	L	CaHCO3
BRR0.4	72293	1015	120		88	23.9	7.3	5.1	1.10	9	30		CaHCO3
CAT0.2	80993	1530	53		2	9.6	5.8	6.0	1.26	5	58		CaSO4
CAT13.0	80993	1300	76		2	10.8	7.4	7.7	1.29	7	81		CaSO4
EBRR4.7	72293	1330	56		20	6.9	2.3			13	10	L	NaHCO3
FSH1.5	81093	1115	41		29	12.0	3.4	5.0	1.24	8	32		CaSO4
FSH15.6	81093	1500	27		12	7.2	2.3	3.9	0.96	6	30		CaSO4
HNL0.2	72093	830	32		24	9.6	2.6	7.0	1.22	10	10	L	CaHCO3
HNL4.5	72093	1015	48		27	12.5	4.4	24.0	1.49	48	10	L	NaCl
HNT0.2	81093	1335	28		20	8.7	2.7	4.5	1.12	8	27		CaSO4
HRV0.1	71993	1315	41		34	13.8	2.6	9.6	1.57	16	12		CaHCO3
HRV6.8	71993	1630	33		24	12.5	1.8	5.5	0.81	10	16		CaHCO3
LFSH0.1	81093	935	68		66	19.8	5.3	7.8	2.03	13	22		CaHCO3
LGT0.1	80993	1758	92		59	35.9	4.0	60.5	8.57	98	36		NaCl
LWR0.3	81093	1237	415		73	71.3	48.3	28.5	4.44	40	250		CaSO4
LWR15.0	80993	1730	144		24	34.1	16.4	25.7	5.31	32	121		CaSO4
LWR36.0	80993	1548	28		32	12.0	1.4	3.5	1.00	5	20	L	CaHCO3
LWR4.0	81093	1130	114		46	23.5	13.4	39.7	6.61	42	79		NaHCO3
LWWP0.1	72093	1700	10		15	6.2	1.9	5.2	1.04	7	10	L	CaHCO3
LWWP6.7	72093	1530	10	L	22	8.6	2.7	11.7	0.87	21	10	L	NaHCO3
MAH0.8	81293	945	162		124	42.8	12.2	25.8	2.55	49	49		CaHCO3
MHO0.1	72293	1713	10	L	24	8.8	1.6	3.4	0.96	6	10	L	CaHCO3
MHO6.5	72193	1141	12		7	3.2	0.7	1.2	0.58	2	10	L	CaHCO3
MSH0.1	72193	1716	25		50	16.0	2.6			10	10	L	CaHCO3
MSH5.3	72193	1537	22		49	13.9	2.5			8	10	L	CaHCO3
NPT0.1	81193	1154	768		112	211.0	119.0	56.3	5.11	10	783		CaSO4
NSK0.7	72193	1815	217		0	25.4	29.1	19.8	2.45	27	200		MgSO4

Sampling Site	Date	Time	Hardness Total		Alkalinity as HCO3	Calcium Total	Magnesium Total	Sodium Total	Potassium Total	Chlorides Total	Sulfate Total		Water Type
	mddyy	hhmm	mg/l	rem	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	rem	
NSK13.2	72193	1330	306		73	33.2	40.1	11.0	3.48	13	289		MgSO4
NSK13.9	72193	1245	10	L	15	7.4	1.5	7.3	0.96	13	10	L	CaHCO3
NTK0.4	81193	1053	431		76	119.0	44.8	63.5	4.10	66	413		CaSO4
RRB0.1	81093	900	96		90	33.6	6.3	32.4	2.92	55	35		CaHCO3
RRC1.1	81193	1150	36		29	8.9	3.1	9.4	1.75	9	20	L	NaHCO3
RRC10.7	81193	1320	32		27	7.5	0.0	3.3	1.24	6	20	L	CaHCO3
SBRC0.5	81193	1550	30		34	7.8	2.5	16.9	2.69	14	20		NaHCO3
SGRR0.3	72193	935	51		54	17.3	2.7	4.6	1.80	4	10	L	CaHCO3
SHK0.1	72093	1315	18		10	6.3	1.9	4.4	0.96	7	10	L	CaHCO3
SHK4.5	72093	1145	31		32	8.6	3.0	10.9	0.68	13	10	L	NaHCO3
SOL0.9	81193	908	472		107	127.0	77.9	60.9	3.99	39	496		CaSO4
SRC0.08	71993	1335	104		105	32.4	6.4	12.5	4.12	19	28		CaHCO3
SRC16.4	71993	1603	110		110	34.7	5.8	12.8	4.17	21	29		CaHCO3
SUSQ125.0	81293	1415	150		76	35.1	14.1	27.9	3.08	40	98		CaSO4
SUSQ134.5	81293	1155	145		95	37.7	11.8	31.1	3.58	45	75		CaHCO3
SUSQ136.0	81193	1700	136		102	35.2	13.6	28.6	2.93	39	89		CaHCO3
SUSQ146.2	81193	940	158		80	43.1	15.7	29.5	2.86	42	102		CaSO4
SUSQ148.5	81093	1730	135		80	36.0	14.6	31.8	3.05	43	93		CaSO4
SUSQ156.0	80993	1045	171		85	38.9	16.0	28.9	6.27	41	109		CaSO4
SUSQ163.0	72293	815	165		98	43.0	13.4	25.5	2.36	36	122		CaSO4
SUSQ171.0	72093	1430	162		88	46.1	14.3			36	93		CaSO4
SUSQ181.0	71993	1445	160		98	45.1	13.7	23.4	2.72	37	87		CaHCO3
SUSQ190.0	71993	1100	150		95	43.7	12.8	25.0	2.46	38	73		CaHCO3
SUSQ198.0	80993	1253	101		98	33.3	8.0	27.4	2.63	43	32		CaHCO3
SUSQ207.0	80993	1022	11		98	33.0	7.9	27.1	2.62	42	30		CaHCO3
SUSQ219.0	72293	1519	114		98	30.5	6.8	26.2	2.35	41	10	L	CaHCO3
SUSQ228.0	72193	1930	80		102	30.0	7.3	27.8	2.29	42	10	L	CaHCO3
SUSQ230.0	72193	2030	76		100	29.0	7.1	23.2	2.16	40	31		CaHCO3
SUSQ254.0	72193	818	100		99	30.6	7.6	23.0	2.27	39	24		CaHCO3
SUSQ269.0	72093	2028	99		98	31.2	7.7	24.3	2.23	41	26		CaHCO3

Sampling Site	Date	Time	Hardness Total		Alkalinity as HCO3	Calcium Total	Magnesium Total	Sodium Total	Potassium Total	Chlorides Total	Sulfate Total		Water Type
	mddyy	hhmm	mg/l	rem	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	rem	
SUSQ271.0	72093	1807	101		98	31.5	7.9	25.2	2.79	44	28		CaHCO3
SUSQ280.0	71993	1030	113		98	30.1	9.2	28.0	3.95	47	33		CaHCO3
TBY0.2	81093	1650	85		44	24.8	7.0	24.2	3.56	36	60		CaSO4
TBY6.7	81093	1514	85		66	28.9	6.0	24.5	2.18	42	42		CaHCO3
TNK0.3	72293	1401	64		54	18.2	2.2	8.6	1.64	14	10	L	CaHCO3
TNK11.3	72293	950	25		49	16.8	2.1	7.5	1.53	12	10	L	CaHCO3
TWN0.1	72093	1937	49		41	15.3	3.1	5.2	1.99	8	22		CaHCO3
TWN16.9	71993	1821	92		66	29.9	4.6	9.7	3.26	17	29		CaHCO3
WBRR2.4	72293	1145	129		93	26.5	8.1	4.3	1.10	7	23		CaHCO3
WSX0.2	72093	1600	51		49	15.5	3.7	6.0	2.53	9	24		CaHCO3
WSX5.0D	72093	1430	39		37	10.0	3.4	7.2	2.81	11	10	L	CaHCO3
WSX6.6	72093	1422	40		32	10.2	3.5	7.4	2.91	11	11		CaHCO3
WWP0.1	72193	830	10	L	15	11.4	2.6	11.3	1.66	16	21		CaSO4
WWP6.4	72193	1000	12		15	16.7	2.2	22.6	2.73	29	33		NaSO4
WYL0.4	72093	1034	88		49	26.9	5.0	58.1	4.31	90	29		NaCl
WYL16.2	72093	824	43		44	11.7	3.6	7.0	2.08	11	21		CaHCO3

Remarks

L Reporting limit— value is less than result shown

Sampling Site	Date	Time	Copper Total		Iron Total		Iron Dissolved		Lead Tot al		Manganese Total		Manganese Dissolved		Nickel Total		Zinc Total		Aluminium Total		Aluminium Dissolved	
	mddyy	hhmm	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem
BLK0.1	72193	1445	50	L	396		100	L	4	L	603		597		50	L	97		840		280	
BLK9.3	72193	1615	50	L	1,030		160		4	L	293		293		50	L	38		473		240	
BOW0.1	72293	1650	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	444		444	
BOW12.5	72293	1810	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	458		407	
BRR0.4	72293	1015	50	L	267		100	L	4	L	50	L	50	L	50	L	10	L	379		248	
CAT0.2	80993	1530	9.82		42		28		1.36		685		685		41.9		179		1,440		1,210	
CAT13.0	80993	1300	14.5		37		25		1.69		970		892		61.2		263		3,010		2,700	
EBRR4.7	72293	1330	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	265		265	
FSI11.5	81093	1115	4	L	100		36		1	L	24		21.2		4	L	5	L	90.7		86.1	
FSH15.6	81093	1500	22.4		21		10	L	1	L	5.6		5.52		4	L	5	L	82.9		84	10
HNL0.2	72093	830	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10		210		176	
HNL4.5	72093	1015	50	L	260		100	L	4	L	77	L	50	L	50	L	46		451		444	
HNT0.2	81093	1335	4	L	75		39		1	L	15.2		10.4		4	L	5	L	101		84.9	
HRV0.1	71993	1315	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	158		150	L
HRV6.8	71993	1630	50	L	663		134		4	L	127		50	L	50	L	18		553		180	
LFSH0.1	81093	935	4	L	84		24		2.39		13.8		36.3	10	4	L	5	L	98.7		79	
LGT0.1	80993	1758	10.8		52		10	L	1.05		9.71		3.32		4	L	17.8		271		266	
LWR0.3	81093	1237	4	L	6,770		4,790		1	L	2,410		2,380		29.7		20		275		262	
LWR15.0	80993	1730	5.48		144		10	L	1.46		75.7		46.8		8.21		24.3		425		357	
LWR36.0	80993	1548	4	L	135		57		1	L	27.2		10.3		4	L	5	L	325		325	
LWR4.0	81093	1130	7.11		277		10	L	2.37		79.6		33.6		5.98		31.3		313		245	
LWWP0.1	72093	1700	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	224		200	
LWWP6.7	72093	1530	50	L	147		100	L	4	L	11		50	L	50	L	10	L	226		214	
MAH0.8	81293	945	4	L	250		26		1.09		47.6		20.7		4	L	5.33		267		97	
MHO0.1	72293	1713	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	432		432	
MHO6.5	72193	1141	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	309		298	
MSH0.1	72193	1716	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	509		466	
MSH5.3	72193	1537	50	L	172		100	L	4	L	73.3		56		50	L	10	L	473		473	
NPT0.1	81193	1154	4	L	43,700		40,000		1	L	7,580		7,750		52.7		28.3		460		241	
NSK0.7	72193	1815	50	L	207		104		4	L	2,840		2,720		108		400		4,790		4,290	

Sampling Site	Date	Time	Copper Total		Iron Total		Iron Dissolved		Lead Tot al		Manganese Total		Manganese Dissolved		Nickel Total		Zinc Total		Aluminium Total		Aluminium Dissolved	
	mddyy	hhmm	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem
NSK13.2	72193	1330	117		2,3800		146		17.13		4,140		3,870		172		592		20,600		6,980	
NSK13.9	72193	1245	50	L	121		100	L	4	L	50	L	50	L	50	L	10	L	258		203	
NTK0.4	81193	1053	4	L	6,620		3,510		1	L	3,410		3,440		14.6		10.7		305		227	
RRB0.1	81093	900	4	L	323		33		1	L	200		158		4	L	17.7		288		259	
RRC1.1	81193	1150	4	L	984		72		1	L	26		11.1		4	L	5	L	135		82.4	
RRC10.7	81193	1320	4	L	191		41		1	L	17.8		8.15		4	L	5	L	144		85.1	
SBRC0.5	81193	1550	4	L	175		50		1	L	18.9		4.69		4	L	5	L	226		91	
SGRR0.3	72193	935	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	400		400	
SHK0.1	72093	1315	50	L	114		114		4	L	50	L	50	L	50	L	12		223		195	
SHK4.5	72093	1145	50	L	167		100	L	4	L	101		75		50	L	10	L	253		185	
SOL0.9	81193	908	4	L	52,800		51,300		1	L	5340		5280		26.7		5	L	251		240	
SRC0.08	71993	1335	4	L	74		10	L	1	L	31.6		12.9		4	L	5.88		150		138	
SRC16.4	71993	1603	4	L	242		30		1	L	81.6		37.9		4	L	5	L	232		157	
SUSQ125.0	81293	1415	4	L	859		37		1	L	110		4.15		4	L	5.14		255		199	
SUSQ134.5	81293	1155	4	L	410		30		1.09		130		77.6		4	L	5	L	352		117	
SUSQ136.0	81193	1700	4	L	104		19		1	L	73.4		10		4	L	5	L	145		136	
SUSQ146.2	81193	940	4	L	219		137		1	L	156		33.1		5.33		10.4		246		168	
SUSQ148.5	81093	1730	4	L	161		29		3.19		84.2		7.05		4	L	5	L	128		236	10
SUSQ156.0	80993	1045	4.39		426		23		1	L	317		168		12.6		23.3		333		157	
SUSQ163.0	72293	815	50	L	405		100	L	4	L	75	10	230	10	50	L	10	L	351		347	
SUSQ171.0	72093	1430	50	L	664		100	L	4	L	123		70		50	L	10	L	241		211	
SUSQ181.0	71993	1445	50	L	1,120		100	L	4	L	235		191		50	L	12		392		193	
SUSQ190.0	71993	1100	50	L	649		107		4	L	213		170		50	L	10	L	245		215	
SUSQ198.0	80993	1253	4	L	162		10	L	1	L	102		9.34		4	L	5	L	368		259	
SUSQ207.0	80993	1022	4	L	130		10	L	1	L	98.3		11		4	L	5	L	401		296	
SUSQ219.0	72293	1519	50	L	170		100	L	4	L	52		50	L	50	L	10	L	572		441	
SUSQ228.0	72193	1930	50	L	213		100	L	4	L	56.7		50	L	50	L	10	L	620		420	
SUSQ230.0	72193	2030	50	L	186		100	L	4	L	52.1		50	L	50	L	10	L	521		487	
SUSQ254.0	72193	818	50	L	177		100	L	4	L	76.6		50	L	50	L	10	L	615		342	
SUSQ269.0	72093	2028	50	L	180		100	L	4	L	74.2		50	L	50	L	10	L	508		508	

Sampling Site	Date	Time	Copper Total		Iron Total		Iron Dissolved		Lead Tot al		Manganese Total		Manganese Dissolved		Nickel Total		Zinc Total		Aluminium Total		Aluminium Dissolved	
	mddyy	hhmm	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem	µg/l	rem
SUSQ271.0	72093	1807	50	L	166		100	L	4	L	76		50	L	50	L	10	L	420		324	
SUSQ280.0	71993	1030	4.82		163		10	L	1	L	86.6		9.44		4	L	5	L	218		139	
TBY0.2	81093	1650	7.75		1,600		460		3.59		252		232		4.39		22.8		473		270	
TBY6.7	81093	1514	4	L	220		117		1	L	49.7		52.8	10	4	L	5.43		275		266	
TNK0.3	72293	1401	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	432		432	
TNK11.3	72293	950	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	497		497	
TWN0.1	72093	1937	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	378		378	
TWN16.9	71993	1821	4	L	93		76		1	L	24.9		13		4	L	5	L	210		175	
WBRR2.4	72293	1145	50	L	186		100	L	4	L	50	L	50	L	50	L	10	L	371		275	
WSX0.2	72093	1600	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	317		317	
WSX5.0D	72093	1430	50	L	141		100	L	4	L	50	L	50	L	50	L	10	L	356		305	
WSX6.6	72093	1422	50	L	130		100	L	4	L	50	L	50	L	50	L	10	L	299		299	
WWP0.1	72193	830	50	L	100	L	100	L	4	L	50	L	50	L	50	L	10	L	218		213	
WWP6.4	72193	1000	50	L	145		100	L	4	L	113		55		50	L	22		301		209	
WYL0.4	72093	1034	4	L	115		115		1	L	28.7		23.6		4	L	5	L	300		238	
WYL16.2	72093	824	4	L	110		31		1	L	42.2		29.4		0.201	L	5	L	241		215	

Remarks

10 Lab analysis indicates dissolved greater than total

L Reporting limit— value is less than result shown

Appendix B
Summary of Organic Pollution Tolerance Values and Functional Feeding Groups
(Source: EPA, 1990)

Order	Family	Genus	Functional Feeding Group*	Organic Pollution Tolerance Value**
Coleoptera	Dytiscidae	*Agabus*	P	5
	Elmidae	*Ancyronyx*	CG	2
		Dubiraphia	SC	6
		Macronychus	SC	2
		Optioservus	SC	4
		Stenelmis	SC	5
	Gyrinidae	*Dineutis*	P	4
		Gyrinus	P	4
	Hydrophilidae	*Berosus*	CG	5
		Laccobius	P	5
		Tropisternus	CG	5
	Psephenidae	*Psephenus*	SC	4
Diptera	Athericidae	*Atherix*	P	2
	Chironomidae		CG	7
	Culicidae		FC	8
	Empididae	*Hemerodromia*	P	6
	Simulidae	*Simulium*	FC	6
	Tabanidae	*Chrysops*	PI	7
		Tabanus	PI	5
	Tipulidae	*Antocha*	CG	3
		Hexatoma	P	2
		Tipula	SH	4
Ephemeroptera	Baetidae	*Baetis*	CG	6
		Centroptilum	CG	2
		Heterocloeon	SC	2
		Neocloeon	CG	6
		Pseudocloeon	CG	4
	Caenidae	*Caenis*	CG	7
	Ephemerellidae	*Drunella*	SC	1
		Ephemerella	SC	1
		Eurylophella	SC	4
		Serratella	SC	2
	Ephemeridae	*Ephemera*	CG	2
		Hexagenia	CG	6
	Heptagenidae	*Epeorus*	CG	0
		Heptagenia	SC	4
		Leucrocuta	SC	1
		Stenacron	SC	4
		Stenonema	SC	3
	Leptophlebidae	*Leptophlebia*	CG	4
		Paraleptophlebia	CG	1
	Oligoneuridae	*Isonychia*	FC	2
	Polymitarcidae	*Ephoron*	CG	2
	Potamanthidae	*Potamanthus*	CG	4
	Tricorythidae	*Leptohyphes*	CG	4
		Tricorythodes	CG	4
Hemiptera	Gerridae	*Metrobates*	P	
	Hydrometridae	*Hydrometra*		
	Veliidae	*Rhagovelia*		

Order	Family	Genus	Functional Feeding Group*	Organic Pollution Tolerance Value**
Megaloptera	Corydalidae	*Corydalus*	P	4
		Nigronia	P	2
	Sialidae	*Sialis*	P	4
Odonata	Aeshnidae	*Boyeria*	P	2
	Coenagrionidae	*Nehalennia*	P	7
	Gomphidae	*Gomphus*	P	5
		Hagenius	P	3
		Ophiogomphus	P	1
		Stylogomphus	P	4
Plecoptera	Leuctridae	*Leuctra*	SH	0
	Peltoperlidae	*Peltoperla*	SH	0
	Perlidae	*Acroneuria*	P	0
		Neoperla	P	3
		Paragnetina	P	1
		Phasganophora	P	2
	Perlodidae	*Isoperla*	P	2
	Pteronarcidae	*Pteronarcys*	SH	0
Trichoptera	Brachycentridae	*Brachycentrus*	FC	1
	Glossomatidae	*Glossosoma*	SC	0
	Helicopsychidae	*Helicopsyche*	SC	3
	Hydropsychidae	*Cheumatopsyche*	FC	5
		Hydropsyche	FC	4
		Macronema	FC	3
		Potamyia	FC	5
		Sympitopsyche	FC	4
	Hydroptilidae	*Leucotrichia*	SC	6
	Leptoceridae	*Mystacides*	CG	4
	Limnophilidae	*Hydatophylax*	SH	2
		Neophylax	SC	3
	Odontoceridae	*Psilotreta*	SC	0
	Philopotamidae	*Chimarra*	FC	4
		Dolophilodes	FC	0
	Polycentropodidae	*Neureclipsis*	FC	7
		Polycentropus	FC	6
	Rhyacophilidae	*Rhyacophila*	P	1
Amphipoda	Gammaridae	*Gammarus*	SH	6
Decapoda	Cambaridae	*Orconectes*	SH	6
Gastropoda	Lymnaeidae	*Lymnaea*	SC	7
	Physidae	*Physa*	SC	8
Isopoda	Asellidae	*Asellus*	SH	8
Oligochaeta	Hirudinae	*Helobdella*	P	6
	Lumbriculidae	*Rhynchelmis*	CG	8
	Naididae	*Nias*	CG	8
	Tubificidae		CG	10
Pelecypoda	Sphaeridae	*Pisidium*	FC	8
Turbellaria	Planaridae	*Dugesia*		4

* Tolerance Values range from 0 (intolerant) to 10 (tolerant).

** Functional Feeding Groups are as follows: SH—Shredder, CG —Collector/Gatherer; SC— Scraper; FC—Filtering/Collector, P— Predator, PI— Piercer

Appendix C
Raw Benthic Macroinvertebrate Data

Order	Family	Genus	HRV 6.8	MSH 5.3	HNL 4.5	SRC 16.4
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus				
		Stenelmis	8	5	4	3
	Gyrinidae	*Dineutis*		5		18
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*				
Diptera	Athericidae	*Atherix*		7	1	8
	Chironomidae		4	18	6	3
	Culicidae		12	10	13	6
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*				
		Centroptilum		6		
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*	6	2		12
		Ephemerella	1			
		Eurylophella	2			2
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*			4	
		Heptagenia				
		Leucrocuta				
		Stenacron		4		
		Stenonema	2			
	Isonychiidae	*Isonychia*	15	11	1	7
	Leptophlebiidae	*Leptophlebia*	17	3	1	2
		Paraleptophlebia		2		
	Polymitarcyidae	*Ephoron*		2	1	
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	HRV 6.8	MSH 5.3	HNL 4.5	SRC 16.4
Megaloptera	Corydalidae	*Corydalus*			2	
		Nigronia				
	Sialidae	*Sialis*	2		10	1
Odonata	Aeshnidae	*Boyeria*		6		7
	Coenagrionidae	*Nehalennia*	1			
	Gomphidae	*Gomphus*				
		Hagenius	3		3	
		Ophiogomphus				
		Stylogomphus		1		
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*	18		5	1
	Perlidae	*Acroneuria*				
		Neoperla	6	10	3	
		Paragnetina				
		Agnetina			1	
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*	1	2	2	
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*				
		Hydropsyche	6		4	10
		Macrostemum			1	
		Potamyia				
		Ceratopsyche				
	Hydroptilidae	*Leucotrichia*	5	4	2	16
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax		1		
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes	1			3
	Polycentropodidae	*Neureclipsis*			31	
		Polycentropus				1
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*				
Gastropoda	Lymnaeidae	*Lymnaea*	1	2		1
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				1
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				1

Order	Family	Genus	WSX 6.6	TWN 16.9	SGRR 0.3	TBY 6.7
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia			3	
		Macronychus				
		Optioservus		3	10	
		Stenelmis	17	22	20	2
	Gyrinidae	*Dineutis*			4	
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	7	9	1	
Diptera	Athericidae	*Atherix*	6	11	6	4
	Chironomidae		25	8	21	48
	Culicidae					
	Empididae	*Hemerodromia*		3		
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma	1			
		Tipula		2		
Ephemeroptera	Baetidae	*Baetis*	2	3		
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*	7	4	11	
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				1
		Serratella				
	Ephemeridae	*Ephemera*	1			
	Heptageniidae	*Epeorus*				
		Heptagenia		1		
		Leucrocuta			3	
		Stenacron	8			1
		Stenonema	5	1	5	5
	Isonychiidae	*Isonychia*		2	3	
	Leptophlebiidae	*Leptophlebia*	4			
		Paraleptophlebia	1			1
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes	8		3	
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	WSX 6.6	TWN 16.9	SGRR 0.3	TBY 6.7
Megaloptera	Corydalidae	*Nigronia*		1		14
	Sialidae	*Sialis*	2	1	5	3
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*	4	1	2	
		Hagenius				
		Ophiogomphus	1			
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*	3		3	2
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*			1	
		Neoperla				
		Paragnetina				
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	3	6	1	5
		Hydropsyche				10
		Macrostemum				
		Potamyia				
		Ceratopsyche	8	15	12	4
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*		10		
		Dolophilodes				1
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*		1		1
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				10
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	WSX 00.2	TNK 11.3	TWN 00.1	BOW 00.1
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia		2		
		Macronychus				
		Optioservus		2	6	1
		Stenelmis	6	11	13	2
	Gyrinidae	*Dineutis*	2	1	1	
		Gyrinus	1			
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	6	16	19	2
Diptera	Athericidae	*Atherix*	2	3	2	10
	Chironomidae		7	11	9	16
	Culicidae					
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus			1	
	Tipulidae	*Antocha*		1		
		Hexatoma	3			
		Tipula				
Ephemeroptera	Baetidae	*Baetis*	2	4	4	5
		Centroptilum	1		3	
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*	2	7	1	2
	Ephemerellidae	*Drunella*				
		Ephemerella		3		7
		Eurylophella				
		Serratella			1	
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia		4		6
		Leucrocuta	8		8	
		Stenacron				
		Stenonema	5	8	3	2
	Isonychiidae	*Isonychia*	10	6	14	11
	Leptophlebiidae	*Leptophlebia*	11			
		Paraleptophlebia	2			
	Polymitarcyidae	*Ephoron*		2	4	
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohyphes*				
		Tricorythodes	4			
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	WSX 00.2	TNK 11.3	TWN 00.1	BOW 00.1
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia		1	1	
	Sialidae	*Sialis*	1	2		3
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius		2		
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*	3			4
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*	2		3	3
		Neoperla				
		Paragnetina				
		Agnetina		1	2	
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*		1		
Trichoptera	Brachycentridae	*Brachycentrus*		4		2
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*		1		
	Hydropsychidae	*Cheumatopsyche*	4	2	5	5
		Hydropsyche				
		Macrostemum				
		Potamyia				
		Ceratopsyche	14	10	4	17
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*		2		
		Neophylax			1	
	Odontoceridae	*Psilotreta*	4			
	Philopotamidae	*Chimarra*			5	1
		Dolophilodes	1	3		
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*	2	1	2	
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	MSH 00.1	WYL 16.2	WYL 00.4	SRC 00.8
Coleoptera	Dytiscidae	*Agabus*				1
	Elmidae	*Ancyronyx*				
		Dubiraphia				1
		Macronychus				
		Optioservus	2	2	5	3
		Stenelmis		13	13	14
	Gyrinidae	*Dineutis*	4	1	2	1
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*		10	6	13
Diptera	Athericidae	*Atherix*	3	13	11	1
	Chironomidae		12	7	12	10
	Culicidae					
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*	4	2	4	8
		Centroptilum				3
		Heterocloeon	1			
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*	5			8
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*			2	
	Heptageniidae	*Epeorus*				
		Heptagenia	5	4	3	
		Leucrocuta	1			1
		Stenacron				4
		Stenonema	3	9	6	2
	Isonychiidae	*Isonychia*	29	6	9	
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia	1			
	Polymitarcyidae	*Ephoron*			1	
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohyphes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	MSH 00.1	WYL 16.2	WYL 00.4	SRC 00.8
Megaloptera	Corydalidae	*Corydalus*			2	
		Nigronia		1		
	Sialidae	*Sialis*	1	2	6	
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*	1	5		1
		Hagenius				
		Ophiogomphus		2		
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*	2	2	2	
		Neoperla				5
		Paragnetina	1			
		Agnetina			3	
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	2	7	10	3
		Hydropsyche				
		Macrostemum				
		Potamyia				
		Ceratopsyche	15	16	13	4
	Hydroptilidae	*Leucotrichia*			1	
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*	19		2	2
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*	2			2
Decapoda	Cambaridae	*Orconectes*	1	2	1	1
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	MHO 00.1	TNK 00.3
Coleoptera	Dytiscidae	*Agabus*		
	Elmidae	*Ancyronyx*		
		Dubiraphia		1
		Macronychus		
		Optioservus		3
		Stenelmis	6	3
	Gyrinidae	*Dineutis*	1	6
		Gyrinus		
	Hydrophilidae	*Berosus*		
		Laccobius		
		Tropisternus		
	Psephenidae	*Psephenus*		
Diptera	Athericidae	*Atherix*	2	5
	Chironomidae		40	17
	Culicidae			
	Empididae	*Hemerodromia*	1	
	Simuliidae			
	Tabanidae	*Chrysops*		
		Tabanus		
	Tipulidae	*Antocha*		1
		Hexatoma		1
		Tipula		
Ephemeroptera	Baetidae	*Baetis*	4	7
		Centroptilum		
		Heterocloeon		
		Cloeon		
		Pseudocloeon		
	Caenidae	*Caenis*	1	10
	Ephemerellidae	*Drunella*		
		Ephemerella		
		Eurylophella		
		Serratella		1
	Ephemeridae	*Ephemera*		
	Heptageniidae	*Epeorus*		
		Heptagenia	18	
		Leucrocuta		
		Stenacron	6	
		Stenonema	8	6
	Isonychiidae	*Isonychia*	3	6
	Leptophlebiidae	*Leptophlebia*		
		Paraleptophlebia		
	Polymitarcyidae	*Ephoron*		2
	Potamanthidae	*Anthopotamus*		
	Tricorythidae	*Leptohypes*		
		Tricorythodes		
Hemiptera	Gerridae	*Metrobates*		
	Hydrometridae	*Hydrometra*		
	Veliidae	*Rhagovelia*		

Order	Family	Genus	MHO 00.1	TNK 00.3
Megaloptera	Corydalidae	*Corydalus*		
		Nigronia		
	Sialidae	*Sialis*		2
Odonata	Aeshnidae	*Boyeria*		
	Coenagrionidae	*Nehalennia*		
	Gomphidae	*Gomphus*		
		Hagenius		
		Ophiogomphus	2	
		Stylogomphus		
Plecoptera	Leuctridae	*Leuctra*		
	Peltoperlidae	*Peltoperla*		
	Perlidae	*Acroneuria*	2	
		Neoperla		
		Paragnetina		
		Agnetina		
	Perlodidae	*Isoperla*		
	Pteronarcyidae	*Pteronarcys*		
Trichoptera	Brachycentridae	*Brachycentrus*		2
	Glossosomatidae	*Glossosoma*		
	Helicopsychidae	*Helicopsyche*		
	Hydropsychidae	*Cheumatopsyche*	1	2
		Hydropsyche		4
		Macrostemum		
		Potamyia		
		Ceratopsyche	12	
	Hydroptilidae	*Leucotrichia*		
	Leptoceridae	*Mystacides*		
	Limnophilidae	*Hydatophylax*	2	
		Neophylax		
	Odontoceridae	*Psilotreta*		
	Philopotamidae	*Chimarra*	4	10
		Dolophilodes		
	Polycentropodidae	*Neureclipsis*		
		Polycentropus		
	Rhyacophilidae	*Rhyacophila*		
Amphipoda	Gammaridae	*Gammarus*		
Decapoda	Cambaridae	*Orconectes*	1	
Gastropoda	Lymnaeidae	*Lymnaea*		
	Physidae	*Physa*		25
Isopoda	Asellidae	*Caecidotea*		
Gnathobdellida	Hirudinidae	*Helobdella*		
Haplotaxida	Lumbriculidae			
	Naididae			
	Tubificidae			
Pelecypoda	Sphaeriidae	*Pisidium*		2
Tricladida	Planariidae	*Dugesia*		

Order	Family	Genus	BOW 12.5	MHO 6.5
Coleoptera	Dytiscidae	*Agabus*		
	Elmidae	*Ancyronyx*		
		Dubiraphia		
		Macronychus		
		Optioservus	1	
		Stenelmis	2	
	Gyrinidae	*Dineutis*		
		Gyrinus		
	Hydrophilidae	*Berosus*		
		Laccobius		
		Tropisternus		
	Psephenidae	*Psephenus*		
Diptera	Athericidae	*Atherix*	4	
	Chironomidae		43	26
	Culicidae			
	Empididae	*Hemerodromia*		
	Simuliidae			
	Tabanidae	*Chrysops*		
		Tabanus		
	Tipulidae	*Antocha*		
		Hexatoma	1	4
		Tipula		
Ephemeroptera	Baetidae	*Baetis*	1	2
		Centroptilum		
		Heterocloeon		
		Cloeon		
		Pseudocloeon		
	Caenidae	*Caenis*	1	
	Ephemerellidae	*Drunella*		1
		Ephemerella		2
		Eurylophella		
		Serratella		
	Ephemeridae	*Ephemera*		
	Heptageniidae	*Epeorus*		
		Heptagenia		
		Leucrocuta		
		Stenacron		1
		Stenonema	1	4
	Isonychiidae	*Isonychia*	2	
	Leptophlebiidae	*Leptophlebia*		
		Paraleptophlebia	2	
	Polymitarcyidae	*Ephoron*		
	Potamanthidae	*Anthopotamus*		
	Tricorythidae	*Leptohypes*		
		Tricorythodes		
Hemiptera	Gerridae	*Metrobates*		
	Hydrometridae	*Hydrometra*		
	Veliidae	*Rhagovelia*		

Order	Family	Genus	BOW 12.5	MHO 6.5
Megaloptera	Corydalidae	*Corydalus*		
		Nigronia	2	5
	Sialidae	*Sialis*	8	
Odonata	Aeshnidae	*Boveria*		
	Coenagrionidae	*Nehalennia*		
	Gomphidae	*Gomphus*		
		Hagenius	1	
		Ophiogomphus		
		Stylogomphus		
Plecoptera	Leuctridae	*Leuctra*	14	8
	Peltoperlidae	*Peltoperla*		
	Perlidae	*Acroneuria*	1	1
		Neoperla		
		Paragnetina		
		Agnetina	5	
	Perlodidae	*Isoperla*		
	Pteronarcyidae	*Pteronarcys*		
Trichoptera	Brachycentridae	*Brachycentrus*		2
	Glossosomatidae	*Glossosoma*		
	Helicopsychidae	*Helicopsyche*		
	Hydropsychidae	*Cheumatopsyche*		1
		Hydropsyche		
		Macrostemum		
		Potamyia		
		Ceratopsyche	3	2
	Hydroptilidae	*Leucotrichia*		
	Leptoceridae	*Mystacides*		
	Limnophilidae	*Hydatophylax*		
		Neophylax		
	Odontoceridae	*Psilotreta*	7	
	Philopotamidae	*Chimarra*		
		Dolophilodes		
	Polycentropodidae	*Neureclipsis*		
		Polycentropus	2	2
	Rhyacophilidae	*Rhyacophila*		
Amphipoda	Gammaridae	*Gammarus*		
Decapoda	Cambaridae	*Orconectes*		
Gastropoda	Lymnaeidae	*Lymnaea*		
	Physidae	*Physa*		
Isopoda	Asellidae	*Caecidotea*		
Gnathobdellida	Hirudinidae	*Helobdella*		
Haplotaxida	Lumbriculidae			
	Naididae			
	Tubificidae			
Pelecypoda	Sphaeriidae	*Pisidium*		
Tricladida	Planariidae	*Dugesia*		

Order	Family	Genus	RRC 10.7	LWWP 0.1	SHK 00.1	BRR 0.4
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus	2	2		1
		Stenelmis	4	1	1	10
	Gyrinidae	*Dineutis*			2	
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	18	13	3	6
Diptera	Athericidae	*Atherix*	20	7	18	9
	Chironomidae		8	12	13	9
	Culicidae					
	Empididae	*Hemerodromia*		1		
	Simuliidae			1		
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*	3	2	1	
		Hexatoma		6		2
		Tipula		1		
Ephemeroptera	Baetidae	*Baetis*	3	12	8	4
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon			2	
	Caenidae	*Caenis*		2	4	
	Ephemerellidae	*Drunella*				
		Ephemerella		2	2	
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*	9		1	2
		Heptagenia		1	10	
		Leucrocuta				2
		Stenacron				
		Stenonema	6	2	1	9
	Isonychiidae	*Isonychia*	10	5	7	6
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	RRC 10.7	LWWP 0.1	SHK 00.1	BRR 0.4
Megaloptera	Corydalidae	*Corydalus*	2			
		Nigronia		1		
	Sialidae	*Sialis*	1		2	1
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*	1			
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*	2	2	1	1
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*	4	6	2	
		Neoperla				
		Paragnetina	3		2	4
		Agnetina		2		
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*		1	3	
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				1
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	2		2	15
		Hydropsyche		2		5
		Macrostemum				
		Potamyia				
		Ceratopsyche	7	21	16	2
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				11
		Dolophilodes	1	5	5	
	Polycentropodidae	*Neureclipsis*	1			
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*		2	2	1
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*	1			
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				1

Order	Family	Genus	EBRR 4.7	LWR 36.0	LWWP 6.7	HNL 00.2
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus	9	4	5	
		Stenelmis		8		
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*		5	1	
Diptera	Athericidae	*Atherix*	3	1	2	2
	Chironomidae		11	13	7	13
	Culicidae					
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma		3		
		Tipula	2			
Ephemeroptera	Baetidae	*Baetis*	7	8	2	10
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon			2	2
	Caenidae	*Caenis*		11		3
	Ephemerellidae	*Drunella*	2		1	
		Ephemerella			2	2
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia	1	5		1
		Leucrocuta				3
		Stenacron				
		Stenonema	2	4		
	Isonychiidae	*Isonychia*	3	3	9	52
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia		4		
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*			1	
	Hydrometridae	*Hydrometra*			1	
	Veliidae	*Rhagovelia*				

Order	Family	Genus	EBRR 4.7	LWR 36.0	LWWP 6.7	HNL 00.2
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia	4	1	4	
	Sialidae	*Sialis*			1	
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*		1		
		Hagenius	2			
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*	4	1	4	2
	Peltoperlidae	*Peltoperla*	4			
	Perlidae	*Acroneuria*	2	4	2	
		Neoperla				
		Paragnetina		6		
		Agnetina			1	3
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*	3			
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*	1			
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	7			1
		Hydropsyche			2	
		Macrostemum				
		Potamyia				
		Ceratopsyche	18	16	10	8
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*		15	17	3
		Dolophilodes	14			14
	Polycentropodidae	*Neureclipsis*				
		Polycentropus			3	
	Rhyacophilidae	*Rhyacophila*				1
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*				
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	HRV 00.1	SRBC 0.5	WBRR 2.4	SHK 4.5
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				2
		Dubiraphia				
		Macronychus				
		Optioservus	2	3	1	10
		Stenelmis	6	1	4	
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				3
	Psephenidae	*Psephenus*	4	7		
Diptera	Athericidae	*Atherix*	1	22	3	5
	Chironomidae		10	19	17	12
	Culicidae					
	Empididae	*Hemerodromia*	3	3		6
	Simuliidae					
	Tabanidae	*Chrysops*			3	
		Tabanus				
	Tipulidae	*Antocha*	1	1		
		Hexatoma				
		Tipula			1	
Ephemeroptera	Baetidae	*Baetis*	5		26	7
		Centroptilum				
		Heterocloeon				4
		Cloeon				
		Pseudocloeon	2			
	Caenidae	*Caenis*	17			
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*			1	
	Heptageniidae	*Epeorus*			1	
		Heptagenia			2	
		Leucrocuta	2			
		Stenacron				
		Stenonema	8	3		11
	Isonychiidae	*Isonychia*	26	6	4	
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*	2			
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				1
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				1

Order	Family	Genus	HRV 00.1	SRBC 0.5	WBRR 2.4	SHK 4.5
Megaloptera	Corydalidae	*Corydalus*		3		
		Nigronia		3		2
	Sialidae	*Sialis*		2	2	
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*		2		
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*		2	1	1
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*	1	5		1
		Neoperla				
		Paragnetina		6		
		Agnetina	5			
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*	3			
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	4		7	26
		Hydropsyche			17	
		Macrostemum				
		Potamyia				
		Ceratopsyche	10	5	14	2
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*	3			
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*			1	
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*		1	2	
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae				1	
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	WWP 0.1	WWP 6.4	MAH 0.8	BLK 0.1
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus	2	2		
		Stenelmis		5	10	
	Gyrinidae	*Dineutis*	1			
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	1	5	4	
Diptera	Athericidae	*Atherix*	4	6	4	5
	Chironomidae		9	23	55	13
	Culicidae					
	Empididae	*Hemerodromia*		1		1
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*		2		
		Hexatoma				
		Tipula				1
Ephemeroptera	Baetidae	*Baetis*	18	5		
		Centroptilum				
		Heterocloeon		2		
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*	1			
	Ephemerellidae	*Drunella*				
		Ephemerella		3		
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*	2			
		Heptagenia				
		Leucrocuta				
		Stenacron			8	
		Stenonema				
	Isonychiidae	*Isonychia*	29	7		
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	WWP 0.1	WWP 6.4	MAH 0.8	BLK 0.1
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia		2		6
	Sialidae	*Sialis*				4
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				
		Neoperla				
		Paragnetina				
		Agnetina	5	4		
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*		1		
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	1			
		Hydropsyche				17
		Macrostemum			2	
		Potamyia				
		Ceratopsyche	21	38	4	7
	Hydroptilidae	*Leucotrichia*			2	
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes	14	1		
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*		2		
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*			2	
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					3
Pelecypoda	Sphaeriidae	*Pisidium*		3		
Tricladida	Planariidae	*Dugesia*			8	

Order	Family	Genus	RRB 00.1	BLK 9.3	TBY 00.2	LGT 00.1
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus				
		Stenelmis	3	4		
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	7			
Diptera	Athericidae	*Atherix*	4			
	Chironomidae		39	72	41	42
	Culicidae			8		
	Empididae	*Hemerodromia*		1		
	Simuliidae			2	18	
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula		4		
Ephemeroptera	Baetidae	*Baetis*				
		Centroptilum				2
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia				
		Leucrocuta				
		Stenacron				
		Stenonema	4			
	Isonychiidae	*Isonychia*				
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohyphes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	RRB 00.1	BLK 9.3	TBY 00.2	LGT 00.1
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia			4	
	Sialidae	*Sialis*	5			
Odonata	Aeshnidae	*Boyeria*	2			
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				
		Neoperla				
		Paragnetina				
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	3	2		5
		Hydropsyche	7	10		1
		Macrostemum				
		Potamyia				
		Ceratopsyche				
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*		4	5	
Decapoda	Cambaridae	*Orconectes*				
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*	11			
Isopoda	Asellidae	*Caecidotea*			12	4
Gnathobdellida	Hirudinidae	*Helobdella*	6		8	2
Haplotaxida	Lumbriculidae		4	6	7	
	Naididae					3
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	NPT 00.1	NTK 00.4	SOL 00.9	LFSH 0.1
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus				1
		Stenelmis				12
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*				11
Diptera	Athericidae	*Atherix*				1
	Chironomidae					10
	Culicidae					
	Empididae	*Hemerodromia*				1
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				5
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*				1
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				2
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia				4
		Leucrocuta				
		Stenacron				
		Stenonema				3
	Isonychiidae	*Isonychia*				16
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	NPT 00.1	NTK 00.4	SOL 00.9	LFSH 0.1
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia				2
	Sialidae	*Sialis*				
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				1
		Neoperla				
		Paragnetina				
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*				4
		Hydropsyche				
		Macrostemum				
		Potamyia				
		Ceratopsyche				28
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes				5
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*				1
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					1
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	FSH 15.6	NSK 13.9	FSH 1.5	RRC 1.1
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus	3	3		1
		Stenelmis		22	10	
	Gyrinidae	*Dineutis*			1	
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	1		18	8
Diptera	Athericidae	*Atherix*	14	3	4	11
	Chironomidae		6	9	8	12
	Culicidae					
	Empididae	*Hemerodromia*				
	Simuliidae		1			
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma		6		
		Tipula		1		
Ephemeroptera	Baetidae	*Baetis*	1	2	3	2
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon	5			1
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*	2			
		Ephemerella				
		Eurylophella				
		Serratella		2	10	
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*		1	17	4
		Heptagenia				
		Leucrocuta			5	
		Stenacron				
		Stenonema	6	2	29	3
	Isonychiidae	*Isonychia*	6	1	19	27
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	FSH 15.6	NSK 13.9	FSH 1.5	RRC 1.1
Megaloptera	Corydalidae	*Corydalus*			7	2
		Nigronia	5	3		4
	Sialidae	*Sialis*		1		
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius	1			
		Ophiogomphus				
		Stylogomphus	2			
Plecoptera	Leuctridae	*Leuctra*	9	6		1
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*	11	1	4	3
		Neoperla			2	
		Paragnetina		6	1	8
		Agnetina			3	
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*		1		
Trichoptera	Brachycentridae	*Brachycentrus*	3			
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*			12	13
		Hydropsyche				1
		Macrostemum				1
		Potamyia				
		Ceratopsyche	24	18	21	15
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*			1	
	Limnophilidae	*Hydatophylax*				
		Neophylax	1			
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*	2	15	5	2
		Dolophilodes	2	2	7	
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*	1	2		
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*	1		1	1
Gastropoda	Lymnaeidae	*Lymnaea*		1		
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	HNT 0.2	LWR 4.0	LWR 15.0	CAT 13.0
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus	2			
		Stenelmis		2	6	
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*		1		
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*	5		1	
Diptera	Athericidae	*Atherix*	3	1	2	1
	Chironomidae		12	46	31	2
	Culicidae					
	Empididae	*Hemerodromia*				5
	Simuliidae				9	
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*			6	
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*	4	2		
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella	3			
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*	5			
		Heptagenia	3			
		Leucrocuta				
		Stenacron				
		Stenonema	6			
	Isonychiidae	*Isonychia*	13			
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	HNT 0.2	LWR 4.0	LWR 15.0	CAT 13.0
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia	7		2	1
	Sialidae	*Sialis*		4	2	
Odonata	Aeshnidae	*Boveria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*	1			
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*	2			
		Neoperla				
		Paragnetina	2			
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	7	22	23	
		Hydropsyche		6		
		Macrostemum				
		Potamyia				12
		Ceratopsyche	25			
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes	9			
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*		4		
Decapoda	Cambaridae	*Orconectes*				
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*		2		
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae				9	
	Naididae					
	Tubificidae			6		
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	NSK 0.7	CAT 0.2	LWR 00.3	NSK 13.2
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus				
		Stenelmis				
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*				
Diptera	Athericidae	*Atherix*	3		4	
	Chironomidae		49	3	24	
	Culicidae					
	Empididae	*Hemerodromia*	1		14	
	Simuliidae		1			
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*				
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia				
		Leucrocuta				
		Stenacron				
		Stenonema				
	Isonychiidae	*Isonychia*				
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*				
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	NSK 0.7	CAT 0.2	LWR 00.3	NSK 13.2
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia	3	1		
	Sialidae	*Sialis*	1	1	2	
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				
		Neoperla				
		Paragnetina				
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*	2			
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*				
		Hydropsyche	1			
		Macrostemum				
		Potamyia				
		Ceratopsyche				
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*				
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae				4	
Pelecypoda	Sphaeriidae	*Pisidium*				
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	SUSQ 125	SUSQ 134.5	SUSQ 136	SUSQ 146.2
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus		12		8
		Stenelmis		25	38	17
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*				
Diptera	Athericidae	*Atherix*				
	Chironomidae			10	8	
	Culicidae					
	Empididae	*Hemerodromia*			1	
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*				
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon				
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia				
		Leucrocuta				
		Stenacron				
		Stenonema		7		2
	Isonychiidae	*Isonychia*		4	3	7
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*				
	Potamanthidae	*Anthopotamus*		5	3	6
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				

Order	Family	Genus	SUSQ 125	SUSQ 134.5	SUSQ 136	SUSQ 146.2
	Veliidae	*Rhagovelia*				
Megaloptera	Corydalidae	*Corydalus*		2	8	
		Nigronia				
	Sialidae	*Sialis*				
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				
		Neoperla				
		Paragnetina				
		Agnetina			2	
	Perlodidae	*Isoperla*				1
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*		3	2	9
		Hydropsyche		5	2	7
		Macrostemum		11	13	16
		Potamyia				
		Ceratopsyche				
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*			2	
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				15
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*		1		1
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*		8		4
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*		4	19	10
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	SUSQ 148.5	SUSQ 156	SUSQ 163	SUSQ 171
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus		1		
		Optioservus	19	10	3	1
		Stenelmis	4	27	7	1
	Gyrinidae	*Dineutis*			3	
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius	4			
		Tropisternus				
	Psephenidae	*Psephenus*		1		
Diptera	Athericidae	*Atherix*				
	Chironomidae		8	37		2
	Culicidae		3			
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*			2	6
		Centroptilum				
		Heterocloeon				
		Cloeon				
		Pseudocloeon			8	
	Caenidae	*Caenis*				
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia	5		11	2
		Leucrocuta			6	5
		Stenacron		8		2
		Stenonema	11	2	5	
	Isonychiidae	*Isonychia*	3			58
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia	4			
	Polymitarcyidae	*Ephoron*			7	4
	Potamanthidae	*Anthopotamus*	4		11	
	Tricorythidae	*Leptohypes*				
		Tricorythodes	5			
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	SUSQ 148.5	SUSQ 156	SUSQ 163	SUSQ 171
Megaloptera	Corydalidae	*Corydalus*				1
		Nigronia		1		
	Sialidae	*Sialis*	4	2		
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*			2	
	Gomphidae	*Gomphus*		1		
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*	3			
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				
		Neoperla				
		Paragnetina				
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*	3			
	Hydropsychidae	*Cheumatopsyche*	4	1	6	6
		Hydropsyche	6	1	3	2
		Macrostemum	3	1	13	45
		Potamyia				
		Ceratopsyche				3
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				3
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*		1		
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*		8		
Decapoda	Cambaridae	*Orconectes*		2		
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*	3			
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*	5	8	15	14
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	SUSQ 181	SUSQ 190	SUSQ 198	SUSQ 207
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus		7		
		Optioservus		6	2	1
		Stenelmis	10	19	29	9
	Gyrinidae	*Dineutis*				
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*				
Diptera	Athericidae	*Atherix*				
	Chironomidae			2	7	3
	Culicidae		3			
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*				3
		Centroptilum				
		Heterocloeon				
		Cloeon			6	
		Pseudocloeon			5	8
	Caenidae	*Caenis*			10	7
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella			6	3
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia		4		
		Leucrocuta			8	8
		Stenacron				8
		Stenonema		3	19	15
	Isonychiidae	*Isonychia*	8	9	17	24
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				1
	Polymitarcyidae	*Ephoron*	1	11		
	Potamanthidae	*Anthopotamus*		5	4	1
	Tricorythidae	*Leptohyphes*				5
		Tricorythodes			7	
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	SUSQ 181	SUSQ 190	SUSQ 198	SUSQ 207
Megaloptera	Corydalidae	*Corydalus*		2	1	2
		Nigronia				
	Sialidae	*Sialis*				
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*		1		
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				1
		Neoperla				
		Paragnetina				
		Agnetina				
	Perlodidae	*Isoperla*				
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	1	4	10	2
		Hydropsyche	3		3	3
		Macrostemum	14	5	6	3
		Potamyia				
		Ceratopsyche	2	3	1	
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*		2		1
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				2
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*				
Decapoda	Cambaridae	*Orconectes*				
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*				
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*	62	24	2	7
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	SUSQ 219	SUSQ 228	SUSQ 230	SUSQ 254
Coleoptera	Dytiscidae	*Agabus*				
	Elmidae	*Ancyronyx*				
		Dubiraphia				
		Macronychus				
		Optioservus	6			
		Stenelmis	27	21	6	
	Gyrinidae	*Dineutis*			2	
		Gyrinus				
	Hydrophilidae	*Berosus*				
		Laccobius				
		Tropisternus				
	Psephenidae	*Psephenus*			5	3
Diptera	Athericidae	*Atherix*				
	Chironomidae		11	11		9
	Culicidae					
	Empididae	*Hemerodromia*				
	Simuliidae					
	Tabanidae	*Chrysops*				
		Tabanus				
	Tipulidae	*Antocha*				
		Hexatoma				
		Tipula				
Ephemeroptera	Baetidae	*Baetis*	2		7	
		Centroptilum	1		3	
		Heterocloeon				
		Cloeon	7			
		Pseudocloeon				
	Caenidae	*Caenis*			3	
	Ephemerellidae	*Drunella*				
		Ephemerella				
		Eurylophella				
		Serratella				
	Ephemeridae	*Ephemera*				
	Heptageniidae	*Epeorus*				
		Heptagenia	9	6	5	29
		Leucrocuta				
		Stenacron		9	7	
		Stenonema		11	11	9
	Isonychiidae	*Isonychia*	4	9		2
	Leptophlebiidae	*Leptophlebia*				
		Paraleptophlebia				
	Polymitarcyidae	*Ephoron*	1	9	13	10
	Potamanthidae	*Anthopotamus*	3	6	12	23
	Tricorythidae	*Leptohypes*				
		Tricorythodes				
Hemiptera	Gerridae	*Metrobates*				
	Hydrometridae	*Hydrometra*				
	Veliidae	*Rhagovelia*				

Order	Family	Genus	SUSQ 219	SUSQ 228	SUSQ 230	SUSQ 254
Megaloptera	Corydalidae	*Corydalus*				
		Nigronia				
	Sialidae	*Sialis*			1	6
Odonata	Aeshnidae	*Boyeria*				
	Coenagrionidae	*Nehalennia*				
	Gomphidae	*Gomphus*				
		Hagenius				
		Ophiogomphus				
		Stylogomphus				
Plecoptera	Leuctridae	*Leuctra*				
	Peltoperlidae	*Peltoperla*				
	Perlidae	*Acroneuria*				
		Neoperla				4
		Paragnetina				
		Agnetina		4		
	Perlodidae	*Isoperla*	4		1	
	Pteronarcyidae	*Pteronarcys*				
Trichoptera	Brachycentridae	*Brachycentrus*				
	Glossosomatidae	*Glossosoma*				
	Helicopsychidae	*Helicopsyche*				
	Hydropsychidae	*Cheumatopsyche*	2	3		
		Hydropsyche	10	7		
		Macrostemum	6	10		
		Potamyia				
		Ceratopsyche		4		
	Hydroptilidae	*Leucotrichia*				
	Leptoceridae	*Mystacides*				
	Limnophilidae	*Hydatophylax*				
		Neophylax				
	Odontoceridae	*Psilotreta*				
	Philopotamidae	*Chimarra*				
		Dolophilodes				
	Polycentropodidae	*Neureclipsis*				
		Polycentropus				
	Rhyacophilidae	*Rhyacophila*				
Amphipoda	Gammaridae	*Gammarus*	3		6	11
Decapoda	Cambaridae	*Orconectes*				1
Gastropoda	Lymnaeidae	*Lymnaea*				
	Physidae	*Physa*			19	
Isopoda	Asellidae	*Caecidotea*				
Gnathobdellida	Hirudinidae	*Helobdella*				
Haplotaxida	Lumbriculidae					
	Naididae					
	Tubificidae					
Pelecypoda	Sphaeriidae	*Pisidium*	4	4	9	
Tricladida	Planariidae	*Dugesia*				

Order	Family	Genus	SUSQ 269	SUSQ 271	SUSQ 280
Coleoptera	Dytiscidae	*Agabus*			
	Elmidae	*Ancyronyx*			
		Dubiraphia			
		Macronychus			
		Optioservus		1	
		Stenelmis		25	5
	Gyrinidae	*Dineutis*			
		Gyrinus			
	Hydrophilidae	*Berosus*			
		Laccobius			
		Tropisternus			
	Psephenidae	*Psephenus*		5	
Diptera	Athericidae	*Atherix*			
	Chironomidae			7	56
	Culicidae				3
	Empididae	*Hemerodromia*			
	Simuliidae				
	Tabanidae	*Chrysops*			
		Tabanus			
	Tipulidae	*Antocha*			
		Hexatoma			
		Tipula			
Ephemeroptera	Baetidae	*Baetis*			
		Centroptilum		5	
		Heterocloeon			
		Cloeon			
		Pseudocloeon			
	Caenidae	*Caenis*			
	Ephemerellidae	*Drunella*			
		Ephemerella			
		Eurylophella			
		Serratella			
	Ephemeridae	*Ephemera*			
	Heptageniidae	*Epeorus*			
		Heptagenia			11
		Leucrocuta			
		Stenacron			
		Stenonema			3
	Isonychiidae	*Isonychia*		5	2
	Leptophlebiidae	*Leptophlebia*			
		Paraleptophlebia			
	Polymitarcyidae	*Ephoron*		8	2
	Potamanthidae	*Anthopotamus*		9	4
	Tricorythidae	*Leptohyphes*			1
		Tricorythodes			
Hemiptera	Gerridae	*Metrobates*			
	Hydrometridae	*Hydrometra*			
	Veliidae	*Rhagovelia*			

Order	Family	Genus	SUSQ 269	SUSQ 271	SUSQ 280
Megaloptera	Corydalidae	*Corydalus*			
		Nigronia			
	Sialidae	*Sialis*			
Odonata	Aeshnidae	*Boyeria*			
	Coenagrionidae	*Nehalennia*			
	Gomphidae	*Gomphus*			
		Hagenius			
		Ophiogomphus			
		Stylogomphus			
Plecoptera	Leuctridae	*Leuctra*			
	Peltoperlidae	*Peltoperla*			
	Perlidae	*Acroneuria*		1	
		Neoperla			1
		Paragnetina			
		Agnetina		2	
	Perlodidae	*Isoperla*			
	Pteronarcyidae	*Pteronarcys*			
Trichoptera	Brachycentridae	*Brachycentrus*			2
	Glossosomatidae	*Glossosoma*			
	Helicopsychidae	*Helicopsyche*			
	Hydropsychidae	*Cheumatopsyche*		1	4
		Hydropsyche		3	1
		Macrostemum		8	
		Potamyia			
		Ceratopsyche			
	Hydroptilidae	*Leucotrichia*			
	Leptoceridae	*Mystacides*			
	Limnophilidae	*Hydatophylax*			
		Neophylax			
	Odontoceridae	*Psilotreta*			
	Philopotamidae	*Chimarra*		3	
		Dolophilodes			
	Polycentropodidae	*Neureclipsis*			
		Polycentropus			
	Rhyacophilidae	*Rhyacophila*			
Amphipoda	Gammaridae	*Gammarus*			
Decapoda	Cambaridae	*Orconectes*			
Gastropoda	Lymnaeidae	*Lymnaea*			
	Physidae	*Physa*		1	
Isopoda	Asellidae	*Caecidotea*			
Gnathobdellida	Hirudinidae	*Helobdella*			
Haplotaxida	Lumbriculidae				
	Naididae				
	Tubificidae				
Pelecypoda	Sphaeriidae	*Pisidium*		5	7
Tricladida	Planariidae	*Dugesia*			